Railway Mechanical Engineer

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APPOINTMENTS OF RAILWAY OFFICERS

OBITUARY

SUPPLY TRADE NOTES

*Indicates photograph.

*Indicates photograph.

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Railway Mechanical Engineer

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The Contents of Our January Issue

The publication of this issue of the *Railway Mechanical Engineer* was delayed for the purpose of giving our readers, as best we might, a review of the happenings in the mechanical department field for the year. The past year has been one of the most interesting in railroad history. Last year at this time the locomotive and car equipment on the railroads of this country was in very poor shape because of the extreme cold weather; the labor situation was extremely critical and large numbers of railway men had gone to France to do their part in relieving the transportation situation there. In this issue we publish a brief story of what was accomplished in France in the matter of handling the cars and locomotives under the jurisdiction of American railway forces. We give also a review of the labor situation and show what has been accomplished in improving the condition of cars and locomotives, together with the number of new cars and locomotives ordered during the year. In addition to this, the January *Railway Mechanical Engineer* contains a very complete article on the West Burlington shops of the Chicago, Burlington & Quincy, which represent, perhaps, the latest practices in railway shop construction.

Supervising Foremen Receive Increases

The compensation for the supervising forces in the mechanical department of the railways has at last been revised and as a general rule when these new rates are compared with what the workmen receive for an eight-hour day, they appear to be satisfactory. Contrary to the manner in which the increases in the workmen's wages was handled, this matter was handled by the regions or districts in which the roads were located rather than by establishing universal rates the country over. The latter method would be quite difficult to handle and have everyone satisfied, as the responsibility and effort required of foremen carrying the same titles vary on different roads. So far as we have been able to learn, however, the rates are sufficiently high to make the positions attractive to competent men. By making a study of the increases which have come to our attention it is found that they are based on a 10-hour day with time and a half over eight hours. This, of course, is a very fair way of approaching the determination of a proper rate, as very few supervising foremen can get through the week without spending many more hours on the job than are required of the workmen.

With the disposition of the Railroad Administration to limit all classes of wage earners to an eight-hour day there will be but little of the dissatisfaction which existed a few months ago when the men were receiving so much overtime, caused by the small differences between the earnings of the wage earners and the supervising forces. It is to be hoped that with this added incentive and with the knowledge that the Railroad Administration is out after a full day's work for a full day's pay, as indicated by Mr. De Guire's address, published in last month's issue, the output and the discipline in the railway shops will improve. The task ahead of the foremen is a difficult one. Had these men been granted their increases along with those granted the workmen last summer the feeling of disrespect and disregard of the foreman's authority would have been prevented to a large extent. It would have been possible to hold some of the competent foremen who found it to their advantage financially to return to the ranks and to have attracted able organizers and leaders of men to the supervising positions. While it will be acknowledged generally that it was a short-sighted policy to follow, the mistake must not be allowed to interfere with a courageous and conscientious policy on the part of the foremen. Any tendency toward Bolshevism and insubordination should not be tolerated. The shop supervisors must get their organizations back into good working shape just as quickly as possible by being absolutely fair with the men, by insisting upon proper respect and a fair output. The time has gone by when labor can be ruled with an iron hand. Courage, discipline and fair-mindedness are now the qualities which distinguish the successful supervisor.

Report on Standard Locomotives

In the annual report of Director General McAdoo, which was not released in time to incorporate in this issue, an outline is given of the reasons for standardizing locomotives. They sum up as follows:

"*First.*—To reduce to a minimum the time required to prepare drawings, patterns and dies and thus enable deliveries to begin more quickly than where separate drawings and patterns would have been necessary for each lot of locomotives allocated to a particular road.

"*Second.*—To insure quantity deliveries. This method of construction has resulted in delivery being made at a quantity rate, which would not have been approached had the locomotives been ordered to individual designs.

"*Third.*—It has also provided a supply of equipment, the parts of which are largely interchangeable, which is available for use anywhere in event of congestion. This removes the necessity of carrying a large stock of repair parts particular to the locomotive and avoids delay which results when repairs must be ordered from some distant owning road."

It may be safely said that thus far none of these aims has been reached. In the first case, new drawings, patterns and dies had to be made for these standard locomotives and it stands to reason that had the roads which needed locomotives been permitted to order locomotives to existing designs, which was so strongly urged last spring, it would have been unnecessary to prepare these new drawings, patterns and dies and that deliveries could have been made much more quickly and with less labor and expense. In fact, to realize anything on this particular point, which by the way considers only the manufacturers of locomotives, standardization would have to extend over many, many years.

The discussion of the first point covers to some extent the second—to secure quantity deliveries. In commenting on this point the director general says: "During five weeks, beginning July 20, an average of 13 1-5 locomotives per week were turned out at the Dunkirk plant (of the American Locomotive Company) while during five weeks beginning September 14, an average of 19 1-5 locomotives per week were turned out at the same plant." The answer to this is that had the roads been permitted to order locomotives to existing designs, as mentioned above, and had not the builders been required to prepare drawings, patterns, dies, etc., for the new standard designs, the average output during the five weeks beginning July 20 would have been larger than that cited by the director general and the railroads of this country would have received locomotives when they needed them most and not after the war was over.

Under the third point the director general says: "This removes the necessity of carrying a large stock of repair parts particular to the locomotive and avoids delay which results when repair parts must be ordered from some distant owning road." During the latter part of the year when the standard locomotives were being placed in service in large numbers, and at the present time, the reverse of this is true. Every road that handles a standard locomotive must enlarge its stock of repair parts in order properly to handle the standard locomotives. The director general in commenting on this point goes on to say: "The importance of this is forcefully illustrated by an instance where a leased locomotive was held out of service until over $4,800 rental had accumulated, waiting for a part which would cost not to exceed $30." This statement, the truth of which is not to be questioned, coming from the source it does, will appear to any practical railroad man as being utterly absurd. Any mechanical department officer that would permit such a thing to happen when he has the shop facilities usually found on a railroad with which to make the missing part costing $30, should not be permitted to hold a position of authority. At best it must be assumed that this was an extreme and isolated instance.

The thought the director general endeavors to convey by this statement applies more particularly to the standard locomotives at the present time than to leased locomotives, for the reason that the owner of a locomotive must have repair parts that are available for the borrowing road, whereas every user of the standard locomotives must either make the new repair parts or obtain them from the equipment manufacturers. As these locomotives are scattered throughout the country, much labor and expense will be involved to provide these parts properly to take care of the locomotives wherever they may be. This third point can only be realized, as in the case of the first and second, after standardization has been in effect for a large number of years, all of which seems to indicate that the director general in following such a plan was giving far more thought to the establishment of a permanent policy for the future than to the immediate problem of winning the war—the only purpose in establishing government operation.

The entire locomotive standardization program, it would seem, favored far more the builders of locomotive equipment than the railroads that are to use these engines. The advantages to the builders will be short-lived and were obtained, as shown above, at a sacrifice in the year's output, while the disadvantages to the railroads will exist 15 or 20 years, or for the life of the standard locomotives they operate. If standardization were to continue it would be 10 to 15 years before any beneficial effect could be obtained from the standard locomotives from a maintenance standpoint. Even after the government releases the control of the roads and the railroads have control of the purchases of locomotives, tools, taps, dies, patterns, etc., must be carried in stock to maintain these standard locomotives. On one road in particular a complete set of patterns will have to be made for the standard locomotives assigned to it, as no part of them is common to those of its own locomotives. Grates, pistons, cylinder heads, cylinders and parts, crossheads, driving boxes, shoes and wedges, ashpan casings, crown brasses, engine trucks, tender trucks and trailer truck brasses and boxes will have to be obtained to meet these new designs. In addition, many fittings are entirely different from those that have been used on that road for many years.

In the case of one road to which a number of the standard locomotives were sent, they were found to be inferior to the road's own locomotives of but slightly less tractive power, particularly in the amount of fuel used. This same road has had much trouble with the stoker equipment, which is of a different design from that used on the road's other locomotives. Engine failures have been caused on account of this, which have delayed traffic and necessitated the use of relief locomotives. The engines were held out of service waiting for repair parts with which to repair the stoker. If the road had had the privilege of specifying the equipment desired it would have ordered that with which its other locomotives were equipped and with which its engine crews were familiar and for which it had a stock of repair parts.

On another road several standard locomotives were delivered almost before the road knew it was to receive them. They were delivered under their own steam and one arrived with the grates burned out. As all grates had to be changed, the engines had to be held out of service until the work was done. The rod packing used on these engines was of a different design from any used on that road, although other standard locomotives were equipped with packing that conformed to its standards. As no packing was sent with the engines, delays were caused until the road procured the proper packing for the engines. One of the engines met with an accident and as there were no spare parts and no drawings of the standard locomotive, a draftsman had to go out on the road to the engine and make a sketch of the parts needed for patterns and forgings to make repairs. This required holding the locomotive out of service for some time.

It will be seen, therefore, that locomotive standardization cannot be considered as a war measure, as the advantages sought could not be obtained unless the war lasted many years. It seems to have been more a part of a well defined scheme for complete nationalization of the railroads in this country.

The Railway Crisis

The director general of railroads has just appeared before the Senate Committee on Interstate Commerce to explain the work of the Railroad Administration during the past year, and to tell why he thought it was necessary to extend government control for a period of five years. He has also made public that part of his report to the President covering the activities of the Division of Operation. Under ordinary circumstances we could well afford to congratulate ourselves upon the fact that the railways of this country made a splendid record during the past year in transporting the increased traffic, made necessary by war conditions, and in helping to win the war. No one wishes to take any credit from Mr. McAdoo or the Railroad Administration, but when the director general deliberately tries to make out a case for the Railroad Administration and show why it should be given a period of five years in which to develop the advantages of unified control under peace conditions, it clearly becomes our duty to disagree with him.

The *Railway Mechanical Engineer* has always been firmly of the opinion that a serious mistake was made when the government took over the actual operation of the railroads. This was unnecessary, as has been clearly shown by the results that have been obtained in Great Britain. That country, on the basis of the experiences in the Franco-Prussian war, made plans for the government control of its railroads during emergency as far back as 1871. When it entered the war in 1914, it took over the control of the roads, but left their operation in the hands of a board of railroad executives. The government simply guaranteed the earnings on the basis of 1913, the pre-war year, and lent all of its authority and power to the railway executives who were placed in charge of the actual operation. As a result, the English railways will probably go down into history as the best managed and operated of any of those of the countries which were engaged in the war.

In this country, a Railroads' War Board had been formed directly after our entry into the war and had given excellent results, considering the fact that it was hampered by the restricting and conflicting regulations of the federal government and 48 states. Two of the factors which were largely responsible for the government taking over control of the railroads were the financial difficulties in which the roads found themselves, because of the rapidly increasing costs and the fact that the Interstate Commerce Commission would not grant an increase in rates, and also because of the serious congestion which was caused, to a very great extent, by the fact that officers in various departments of the government were allowed to issue priority orders without regard to other departments and with no relation to the real order or necessity in which the material was actually required.

The government, by simply taking control and guaranteeing the earnings, and leaving the operation in the hands of the Railroads' War Board, with full responsibility, could undoubtedly have done all that the director general of railroads was able to do and not with the break-down of morale which followed when Mr. McAdoo made such radical changes last winter. One of the greatest shortcomings of the Railroad Administration has been that it has not given the thought which it should to the importance of the human factor in railroad operation. Whether it intended to have it so or not, the impression was widespread that it deliberately intended to discredit the officers. The effect of this upon the morale and discipline throughout the entire organization was disastrous. It is perfectly true that many of the things that were done by the director general, looking toward unification of operation and facilities, were productive of good results. It must be remembered, however, that many of these things had been proposed by the Railroads' War Board but could not be carried out because of laws and regulations under which the railroads were formerly forced to operate.

The labor problem, under private management, was a most serious one. There is no reason, however, why it could not have been solved just as well by railroad executives as by the director general, providing the Interstate Commerce Commission had granted the necessary increase of rates, and this the commission could have been forced to do by the government. One splendid thing has been accomplished by Mr. McAdoo and his Railroad Administration, and that is that so much publicity has been given to the railroad problem, that the public generally is thoroughly awakened to it and is beginning to take the intelligent interest that it should in its final solution. President Wilson frankly stated to Congress that he had no solution for the railroad question, but only a few days later Mr. McAdoo announced that it would be necessary to grant a five-year extension for government control and that if Congress did not take immediate steps in this direction, the roads would be turned back to their owners without any opportunity for remedial legislation. The announcement was also made that the President agreed with him as to this. Just why statements should have been made that it would be necessary to turn the roads back immediately to their owners if the extension was not granted has never been made clear, and there are not a few who suspect that Mr. McAdoo was trying to stampede Congress and the railway executives and force them to the five-year plan.

Fortunately, Congress was not stampeded and the Senate Committee on Interstate Commerce is now engaged in holding a series of hearings during which representatives of all of the important organizations or interests will be heard. Manifestly, it will not be possible to handle the matter to completion during the present session of Congress, which ends next March. The railroad problem, however, is of such tremendous importance to the nation at large that the President will be fully justified in calling a special session of the new Congress to continue the studies and develop the necessary legislation.

Many different plans have been put forward in order to provide the legislation which will be necessary before the roads can safely be returned to their owners. Unless some provision is made to guarantee their financial returns or to insure adequate revenues, it will be disastrous to return the roads to their owners. Moreover, the railroads must be relieved of the conflicting and restrictive regulation of the federal and 48 state commissions; this can possibly best be done by federal incorporation, thus bringing all of the railroads directly under the federal authorities and, at the same time, insuring that careful attention will be given to the issuance of securities which will tend to restore confidence on the part of the security holder and investors. In order to retain those features of unified operation that have given good results during the past year, it will be necessary to repeal the Sherman act, so far as it relates to the railroads. The central regulating authority will have to be more constructive and have a larger responsibility than is now given to the Interstate Commerce Commission. Doubtless, it will be necessary to reorganize and enlarge this commission, and the suggestion has come from other sources that a secretary of transportation be appointed, who will report direct to the President and be a member of his cabinet.

It is noteworthy that the Interstate Commerce Commission has gone strongly on record before the Senate Committee against government ownership and that it believes that it will be advisable to retain a certain amount of competition between the different roads, in order to develop initiative and give the public the best possible service.* One of the most difficult phases of the whole problem is the so-called "weak sisters". These are the weaker and less favorably located roads that cannot exist on rates that would give a good return to the stronger roads. Many suggestions have been made as to combinations which might be formed, and there have been strong advocates of dividing the country into various regions and unifying railroad operation in each region. On the other hand, there has been quite some opposition to this proposal, and the Interstate Commerce Commission in particular suggests that the problem might be solved in a more logical way by arranging for a combination of the weaker roads with adjacent strong roads. Such combinations would, of course, have to be carefully supervised, and it would be specially important not to allow any of the weaker roads to be isolated, so that they would have to stand by themselves.

Hundreds of suggestions are being made as to how Congress should handle the entire problem. It is of great importance that the return of the railroads to their owners should be accomplished with as little disturbance to the public as possible, and that there should be no attempt at experimentation, or in taking radical and unnecessary steps. The railroads of this country pay the best wages and give the best service, at the lowest cost, of any railroads in the world. Common sense would seem to indicate that it will be wise to remove those restrictions that have hampered the continued development of the roads and that, if necessary, the solution of the railroad problem be made in more than one step, if it is not possible clearly to determine the final solution without too much experimentation.

Cost of Locomotive Repairs

While it is extremely difficult with the statistics now at hand to obtain a precise idea of the increase in the cost of locomotive repairs during the past year, sufficient information is obtainable to show that it has increased at a tremendous rate. This is due, of course, very largely to the fact that on account of the war, prices of labor and material have increased greatly. It is also due to the fact that a very strong effort has been made during the past year to keep locomotives in repair and to build up a reserve of power for the winter months to preclude any serious shortage of power such as crippled the roads so badly during the extreme winter last year. The very trying experiences of last winter made it apparent that drastic steps must be taken to prevent its recurrence and when the weather became more favorable in the Spring the Railroad Administration was determined that locomotives should be repaired regardless of cost. The shop hours were increased to 70 hours a week, wages were very materially increased and a basic eight-hour day granted in order to keep the men on locomotive work. Engines were sent to foreign shops that were able to handle repairs in addition to their own; old locomotives that under ordinary conditions would have been scrapped were repaired and every step possible taken to improve the locomotive condition situation.

It has been difficult to get a very comprehensive idea of the increases in the cost of locomotive repairs due to the fact that most of the roads have included in their monthly statements back pay for preceding months. From those roads on which the amount of back pay was deducted from the cost of repairs it has been found that 100 per cent. increase in the cost of locomotive repairs per locomotive mile over pre-war conditions is a very conservative estimate. On one road in particular, the cost of repairs per locomotive mile for June, 1918, was 113 per cent. greater than in June, 1916. In August, 1918, it was 114 per cent. greater and in October, 1918, 91 per cent. greater than the corresponding months in 1916. For the first ten months of 1918 the costs were 76 per cent. greater than for the same period in 1916. This, however, does not show the real situation, as none of the back pay for the first part of the year was included in the comparison. On another road a fair estimate for the first six months of 1918 was 100 per cent. greater than for the same six months in 1916. The locomotives being now in such good condition, as reflected by the reports from Washington, which are published elsewhere in this issue, and the extreme demand for power removed, it is to be anticipated that the cost of locomotive repairs for the coming year should be less.

NEW BOOKS

Proceedings of the American Railway Master Mechanics' Association. Edited by V. R. Hawthorne, secretary. 528 pages, 33 plates, 6 in. by 9 in., bound in cloth. Published by the association, 746 Transportation building, Chicago. Price $5.

The fiftieth volume of the Master Mechanics' Association Proceedings, which has just been issued, covers the activities of the organization during the years 1917 and 1918. A large part of the book is devoted to an account of the convention of 1918, which includes several valuable committee reports. The report on the shop manufacture and repair of semi-elliptical springs covers the subject very thoroughly. The report on the design and maintenance of locomotive boilers is devoted principally to a discussion of the field for autogenous welding in boiler work. The committee on fuel economy and smoke prevention outlined briefly the problem of fuel economy on railroads and made specific recommendations concerning the methods of handling storage coal. The committee on train resistance and tonnage rating submitted data secured from train resistance tests and engine tests. Several important changes were made in the specifications, standards and recommended practices of the association. The development of feedwater heaters is covered very thoroughly in an individual paper by J. Snowden Bell.

Proceedings of the International Railway General Foremen's Association.—Compiled and published by William Hall, secretary of the association. 63 pages, 6 in. by 8¼ in., illustrated, bound in leather.

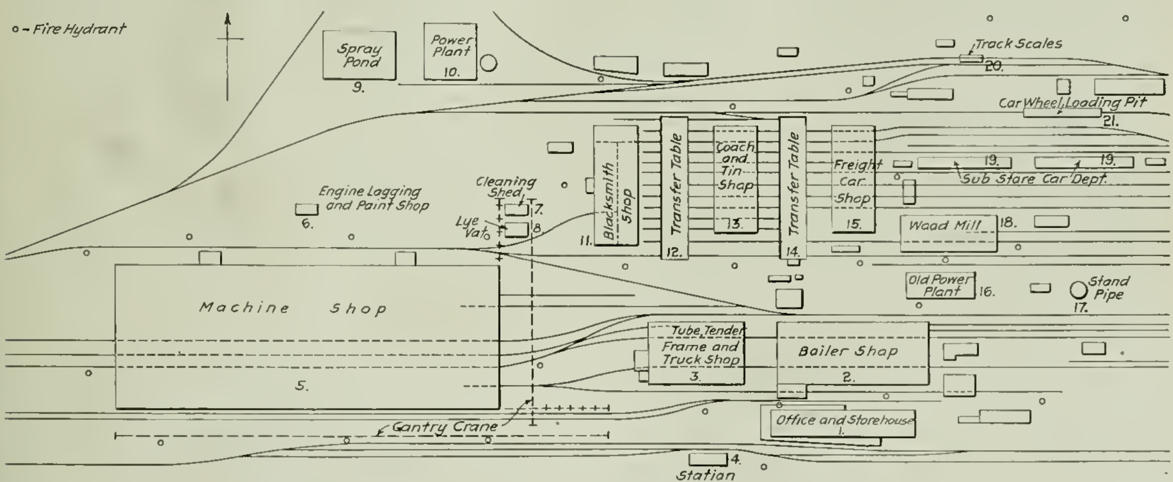
Although the International Railway General Foremen's Association did not hold a convention during 1918, it has in an endeavor to carry on its work of improving mechanical department conditions published the papers prepared by its members which would have been presented had a convention been held. The association is to be congratulated on thus attempting to keep alive its good work and its various members will undoubtedly appreciate the time and effort taken by the committee members in preparing papers for their benefit. The proceedings contain an address by President North, superintendent of shops of the Illinois Central at Chicago, by Robert Quayle, general superintendent motive power and machinery of the Chicago & North Western and by Dr. Frank Crane and in addition the annual report of the secretary-treasurer. The following subjects were discussed by various members of the association: What effect has the war had upon your shop methods and what changes for the better are the result thereof?—The mileage of a locomotive; its relation to the cost of shop and running repairs; who should determine when to shop an engine and who should furnish the work report?—Economical and necessary electrical equipment for railroad shops and roundhouses—Is the flat rate of pay for various classes of labor a success? Should the minimum rate accepted by various organizations be the maximum rate allowed by employers?—How best can greater output by unit of labor be obtained—and, How can uniform classification of repairs to locomotives be brought about?

West Burlington Shops of the C. B. & Q.

Equipment and Operation of New Erecting and Machine Shop, Blacksmith Shop and Power Plant

In 1917, the Chicago, Burlington & Quincy made extensive additions to its shops at West Burlington, Iowa. These included a new power plant, a blacksmith shop, and a combined machine and erecting shop which surpasses in size any similar structures that have yet been built. The expansion of the facilities at this point was made necessary by the increase in the amount of motive power in the district which the shop served and the crowding of neighboring shops. West Burlington is on the main line between Chicago and Omaha, and points farther West. The other principal shops on this line are at Aurora, Ill., 173 miles east of West Burlington and at Havelock, Neb., 336 miles to the West. Burlington, Iowa, four miles east of West Burlington is an important division point on the main line between Chicago and Omaha and is the center of a net work of feeders running throughout western Illinois, Iowa and Missouri. The shops are therefore centrally located with respect to a large amount of motive power.

The problem involved in enlarging the shop was one often met with, namely, to utilize existing facilities to the best advantage in connection with a large extension. The shops as they stood prior to 1917 were built in 1882. At this time a tract of land comprising 640 acres was purchased and the West Burlington shops were erected, much of the equipment being moved out from Burlington. The plant as built at that time comprised seven principal buildings; a storehouse

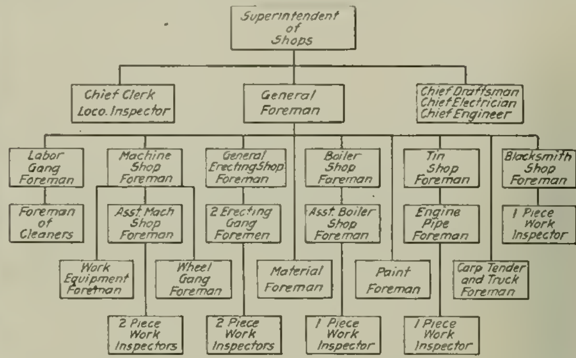


Plan of Tracks and Buildings, West Burlington Shops

List of Buildings

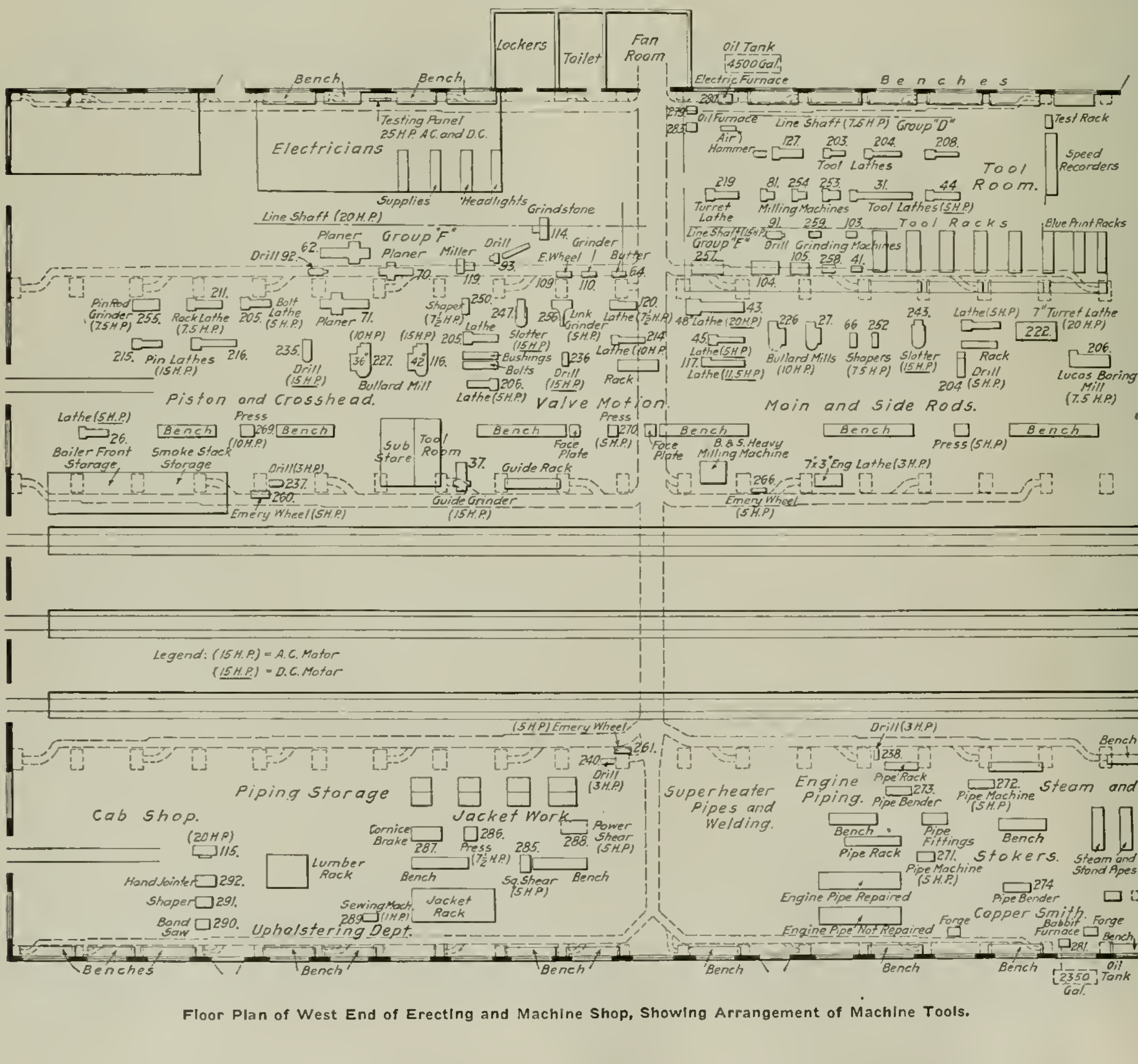
		Material	Size	Year built
1	Office and storehouse	Brick	55 ft. 8 in. by 301 ft. 6 in.	1882
2	Boiler shop	Brick	125 ft. 1 in. by 315 ft. 8 in.	1882
3	Tube, tender frame and truck shop	Brick	125 ft. 1 in. by 200 ft.	1882
4	Station	Wood	20 ft. by 50 ft.	
5	Machine shop	Steel and brick	310 ft. by 792 ft.	1916
6	Eng. lagging and paint shop	Stucco	18 ft. by 52 ft.	1917
7	Cleaning shed	Stucco	18 ft. by 52 ft.	1917
8	Lye vat	Concrete	28 ft. by 28 ft.	1916
9	Spray pond	Concrete	100 ft. by 150 ft.	1916
10	Power plant	Steel and brick	106 ft. 8 in. by 118 ft.	1916
11	Blacksmith shop	Steel and brick	90 ft. by 250 ft.	1916
12	Transfer table	Stone	58 ft. by 3C0 ft.	1882
13	Coach and tin shop	Brick	90 ft. by 222 ft.	1882
14	Transfer table	Stone	58 ft. by 300 ft.	1882
15	Freight car shop	Brick	90 ft. by 22 ft.	1882
16	Old power plant	Brick	140 ft. 8 in. by 52 ft. 10 in.	1882
17	Stand pipe	Steel	28 ft. diam. 60 ft. height	1909
18	Wood mill	Brick	75 ft. by 200 ft.	1882
19	Sub, store car dept.	Wood	11 ft. by 175 ft.	1900
20	Track scales	Wood	8 ft. by 50 ft.	
21	Car wheel loading pit	Concrete	22 ft. 6 in. by 110 ft. 1 in.	

Bolt Department in the Light Machine Bay

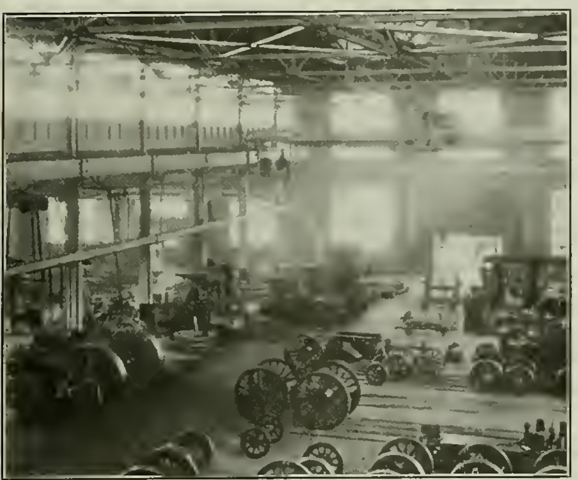


Organization Diagram for the Locomotive Department

and office, a machine and erecting shop with longitudinal pits, (now used as a boiler and tank shop), a boiler and blacksmith shop, (now the flue and tender truck repair shop), a coach shop, a freight car shop, a wood mill and a power house. The main entrance to the shops was from the east, and expansion in that direction was impracticable because the adjoining land was occupied by an iron foundry. The land at the west end of the shops was level and the location of buildings on that side would not inter-



Floor Plan of West End of Erecting and Machine Shop, Showing Arrangement of Machine Tools.



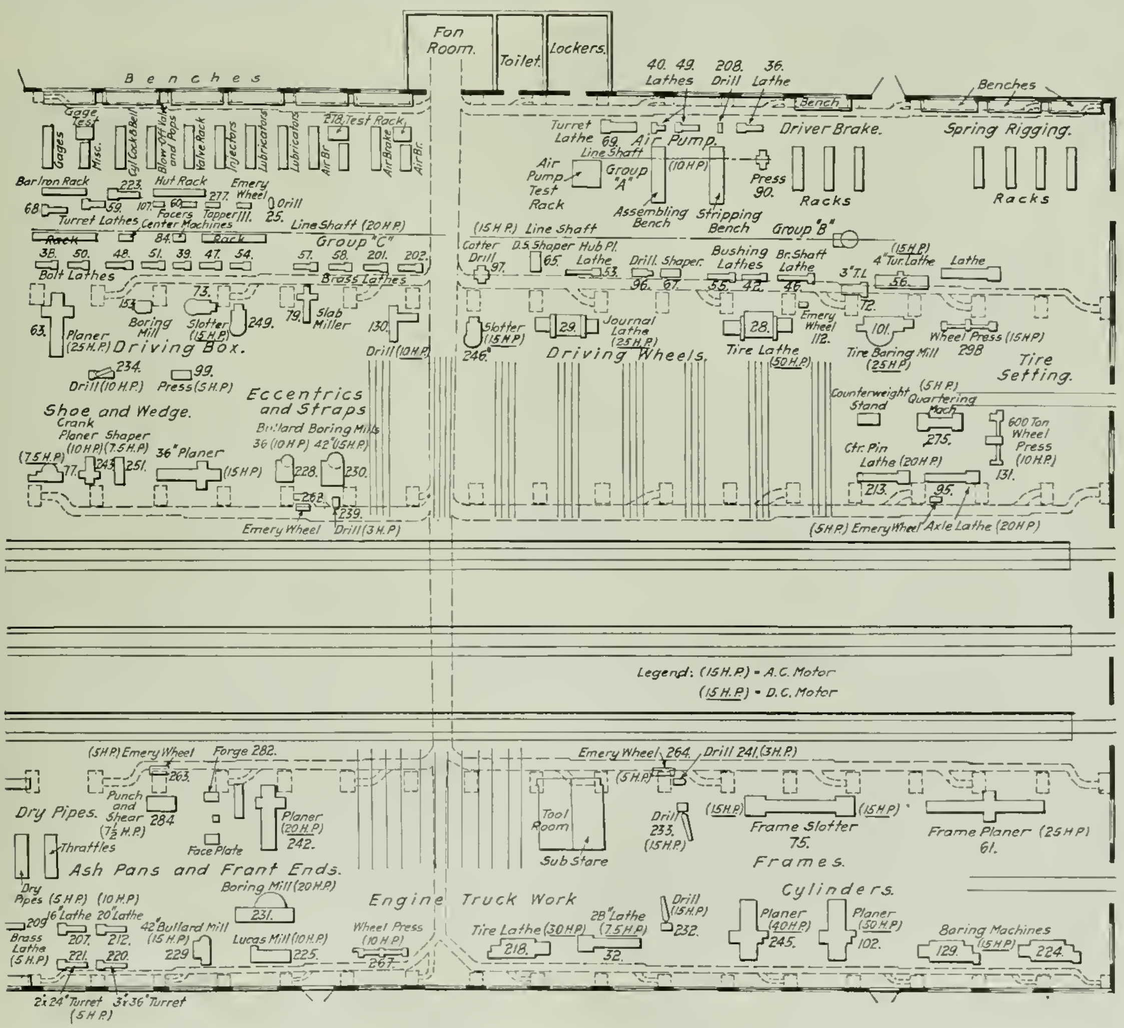
Wheel Department in the Heavy Machine Bay

fere with the car department to any appreciable extent, so it was decided to place the new shops west of the existing plant. A study of the requirements showed that but one department could be housed in the old shop buildings. It was therefore decided to build a combined erecting and machine shop, a blacksmith shop and power plant in the locations shown on the map below. The new erecting shop has a capacity of approximately 30 large or 45 small locomotives, including two or three being stripped and three or four being wheeled and finished.

STRUCTURAL DETAILS OF BUILDINGS.

The buildings in the new plant were erected by Westinghouse, Church, Kerr & Company, New York. The machine and erecting shop is a steel frame building 792 ft. long and 310 ft. wide. The total floor area is 5.65 acres. The entire floor space is made of concrete. The foundation is of concrete and the walls are concrete and glazed hollow tile. The roof is made up of three-inch Douglas fir planks, supported on fir purlins and covered with tar and gravel. The building is divided longitudinally into four bays, one for the erecting shop, two for heavy machines and one for light machines.

The erecting shop occupies a bay 100 ft. wide and three pits, spaced 30 ft. apart, run longitudinally through its entire length. There are four cranes spanning the bay, two of 125 tons' capacity with 15-ton auxiliary hoists on the



Floor Plan of East End of Erecting and Machine Shop, Showing Arrangement of Machine Tools.

upper runway and two of 15 tons' capacity on the lower runway.

On the south side of the erecting shop there is a bay 70 ft. wide served by one 15-ton crane. This part of the building contains some of the heavy machine tools, but the greater part of the space is used for overhauling engines, trucks, ash pans, steam pipes, superheaters, stokers and

Half-Gantry Cranes Along Side and End of Shop

stoker engines and cabs. A standard gage track leads into the east end of this bay.

A heavy machine bay is placed on the north side of the erecting bay. It is 70 ft. wide and has two 15-ton electric traveling cranes covering the entire area and has a stub track leading into it from the east. Along the north side of the shop is the light machine bay, 70 ft. wide. This section has no traveling crane but numerous jib cranes are provided for the heavier work. The tool room is located midway along

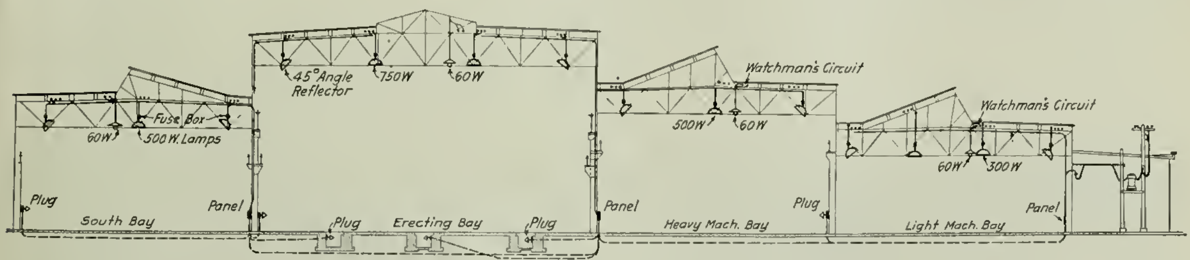
The Rod Department

this bay. In one corner there is a room for the storage of hand tools and blue prints, and directly above this is the foreman's office.

The walls of the shop have a large area of windows which are set in steel sash having sections pivoted horizontally to provide for ventilation. The natural light is increased by a double pitch skylight in the erecting bay and sawtooth skylights running almost the full length of the three remaining bays. A good idea of the uniform lighting across the shop can be gained by referring to the cross section of the building.

Interior of Erecting Shop

The shops are lighted at night by nitrogen filled lamps in enameled steel reflectors. The general illumination is ample for working on machine tools or around locomotives. Plug receptacles are provided, however, spaced 20 ft. apart in the erecting pits and 40 ft. apart on the walls and col-



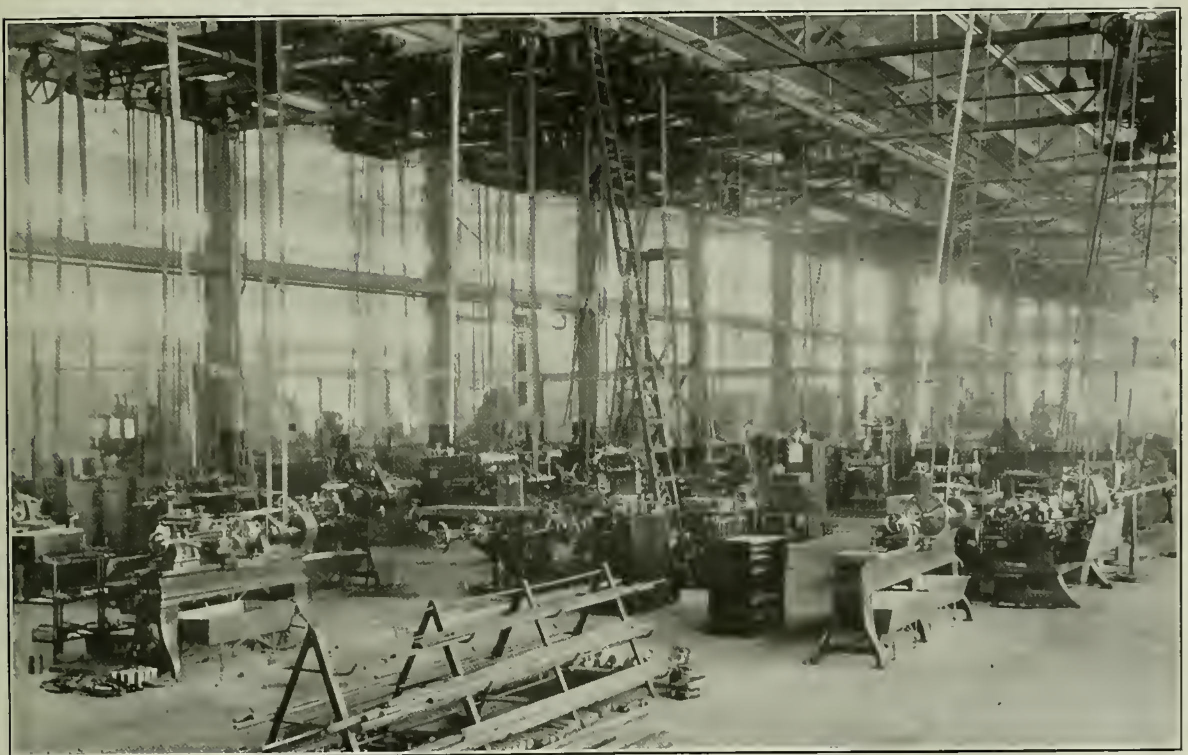
Cross Section of Shops, Showing Arrangement of Lighting Fixtures

umns. Data concerning the lighting installation is given in the following table:

DATA ON ILLUMINATION OF WEST BURLINGTON LOCOMOTIVE SHOPS

	Approximate height	Number of lamps	Size of lamps	Watts per sq. ft.	Approx. ft. candle intensity
Light machine bay	23 ft.	144	300	.78	5.5
Heavy machine bay	33 ft.	87	500	.78	5.0
Erecting shop	50 ft.	72	750	.68	4.5
South bay	33 ft.	87	500	.78	5.0

An indirect fan system of heating is used. The air is drawn in at two fan rooms which extend out from the north wall. The fan forces the air through the heating coils, which are supplied with exhaust steam from turbines, and one air compressor in the power plant and thence into concrete ducts under the floor. These ducts branch into smaller tile ducts which are carried up to sheet metal cowls with outlets about three feet above the floor. During extremely warm weather this system can be used for forcing air through the shop to create an artificial circulation. The water supply for fire protection is taken from two reservoirs about half a mile from the shop. The pumps discharge into a stand pipe 28 ft. in diameter and 60 ft. high, having a capacity of 275,000 gal. Hydrants are spaced from 200 to 400 ft. apart around the shop. A separate pipe line is provided for drinking water. The main toilet rooms are located in the additions, which house the ventilating fans, several auxiliary toilets being provided at convenient points in the shop. The wash rooms and locker rooms are on the second floor of the two additions.



Interior of the Tool Room

The blacksmith shop is a brick building with a steel frame and concrete foundation 250 ft. long and 90 ft. wide. A louver with pivoted steel sash windows in each side extends along the center to provide an outlet for smoke and gases. The roof is of the same type used on the erecting and machine shop.

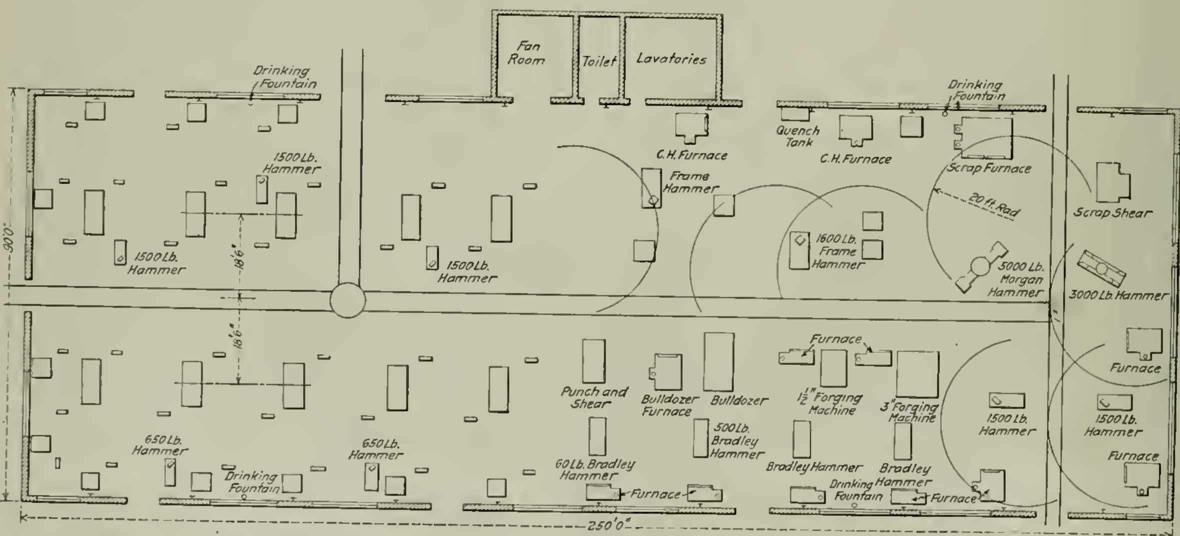
The power house is a steel frame brick building 118 ft. by 107 ft. with a basement under both the boiler and the engine rooms. It has a reinforced concrete roof covered with tar and gravel. The two buildings which are now used for the boiler, flue and tank work, are 125 ft. wide and 316 and 200 ft. long. The walls are of brick and composite wood and iron trusses support the roof, which is of wood with an asbestos covering.

DIVISION OF FLOOR SPACE BETWEEN DEPARTMENTS.

The proper division of floor space between the various departments of a locomotive shop presents a difficult problem. In determining the allotment it is necessary to consider

Frame and Cylinder Equipment in the South Bay

among other factors the class of repairs to be handled, the average period for the renewal of tubes and fireboxes, and the amount of manufacturing work to be done for other shops. Practically all the locomotives repaired at West



Floor Plan of the Blacksmith Shop

Burlington are given a general overhauling. Flues are removed after the engines have run about 80,000 miles, and fireboxes are renewed on the average every five years. The areas of the principal departments in the locomotive shop are given below:

Area of Shops

	Size	Area	Area per pit*
Erecting shop	100 ft. by 792 ft. =	79,200 sq. ft.	2,640 sq. ft.
Machine shop	210 ft. by 792 ft. =	166,300 sq. ft.	5,543 sq. ft.
Erecting and machine	310 ft. by 792 ft. =	245,500 sq. ft.	8,183 sq. ft.
Boiler and tank shop	125 ft. by 316 ft. and 125 ft. by 200 ft. =	64,500 sq. ft.	2,150 sq. ft.
Blacksmith shop	90 ft. by 250 ft. =	22,500 sq. ft.	750 sq. ft.
Total of four main departments		332,500 sq. ft.	11,083 sq. f.t

General Foreman's Office and Small Tool Stock Room

Relative Size Compared to Erecting Shop

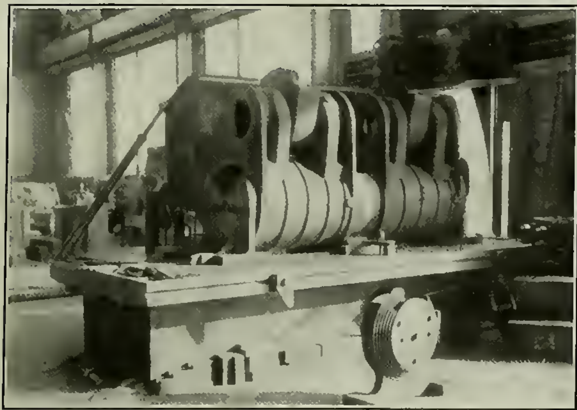
Erecting shop	100.0
Machine shop	210.0
Total erecting and machine shop	310.0
Boiler and tank shop	81.5
Blacksmith shop	28.4
	419.9

Relative Size of Main Departments

Erecting shop	23.8
Machine shop	50.0
Total erecting and machine shop	73.8
Boiler and tank shop	19.4
Blacksmith shop	6.8
	100.0

*Based on shop capacity of 30 locomotives.

The large area devoted to machine work is one of the striking features of the shop. The allotment was made with two objects in mind; first, to furnish ample space around all machines for the stock of parts undergoing repair, and second, to permit of arranging the machines in the order that would eliminate backward movements as far as possible. It



Cylinder Set Up on Jigs for Planing

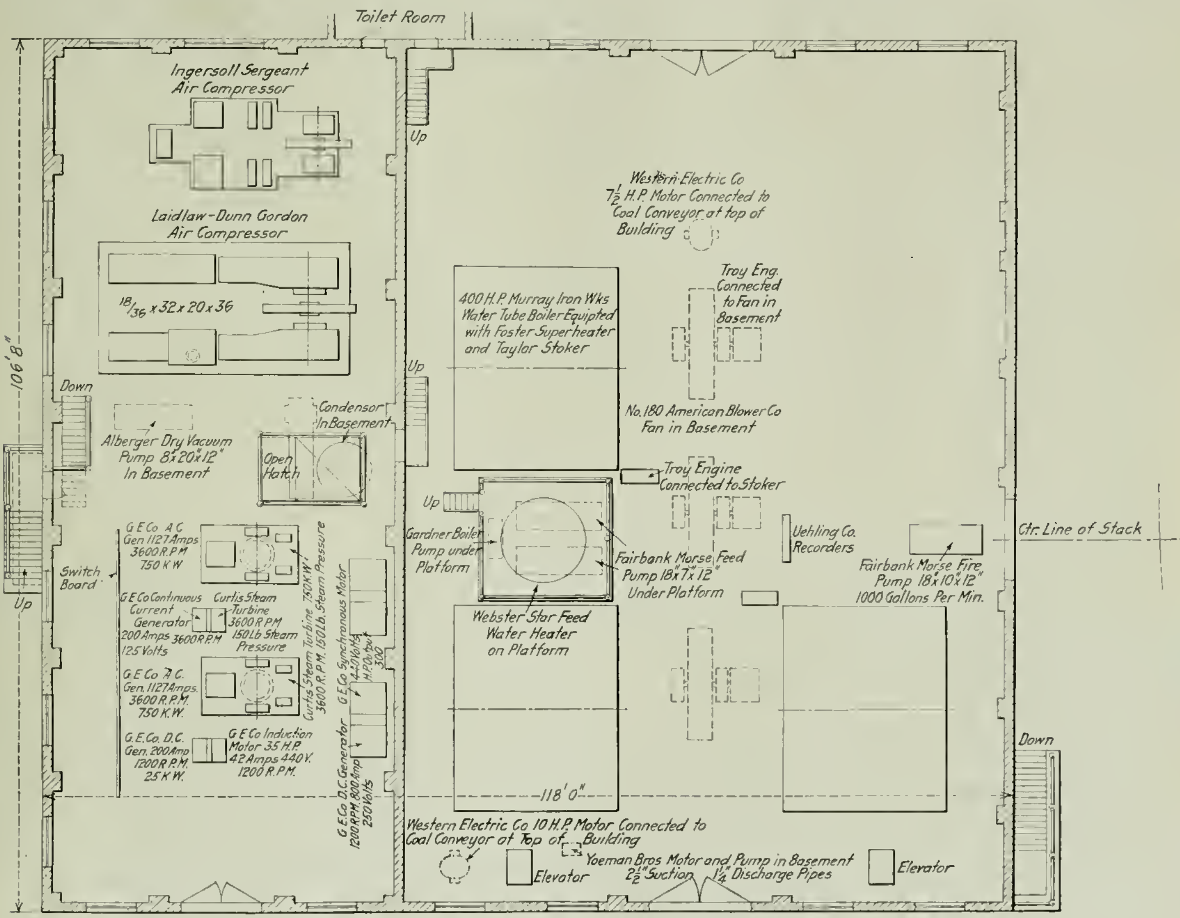
should be noted that the machine shop area includes also the sub-department in which the ash pans, front ends and superheater units are repaired, although this amounts to less than 10 per cent of the total floor space. Furthermore the shop finishes cylinders and other parts for some of the smaller repair points on the system. The space devoted to blacksmith work is relatively small by comparison with the average for older shops, although work for both locomotives and cars is handled here. This is undoubtedly to be explained by the increase in the parts for which steel castings are used, with a consequent reduction in the number of forgings that has occurred in recent years.

ORGANIZATION.

The organization of the supervising force in the locomotive department is shown in the diagram. This is closely in accord with general practice and little comment is necessary. It should be noted that piece work is in effect in practically all departments, which accounts for the small number of foremen in the main sections.

ROUTING OF PARTS BEING REPAIRED.

In locating the sub-departments a special effort has been made to group them in a logical order so that related parts are kept together, so that the distance material must be hauled will be reduced to the minimum and so that the parts will all be moving in the same general direction. The location of the machine tools in each sub-department has been studied and they have been arranged to permit material undergoing repairs to pass from one to another in regular order without any back movement. Thus the normal routing for the parts is from the erecting shop to the end of the sub-department nearest the stripping pit, and thence through the machines in rotation, coming out completed at the end of



Arrangement of Equipment in Power Plant

the department nearest the finishing pits. This arrangement is treated in detail in the description of the sub-departments later in this article.

Ample facilities have been provided for transporting the work in the shops and from one building to another. The erecting shop, as already noted, is served by two 125-ton cranes with auxiliary hooks for lifting 15 tons, and two cranes of 15 tons' capacity running on the lower track. The bay in which the heavy machines are located has two 15-ton cranes and the south bay has one of the same capacity. Along the south wall of the shop there is a track for a 10-ton half-gantry crane, extending nearly to the storehouse. Under this crane most of the heavy material such as cylinders, tires, etc., is stored. The east side of the machine and erecting shop is served by a 50-ton half-gantry crane which reaches the ends of the tracks into the shop and runs beyond the north boundary of the shop to the lye vats. As the runway for this crane extends a short distance under the runway of the 10-ton gantry it is easy to transfer the material by means of these two cranes from the material platform to cars or trucks that can be run into the shop. The flue shop and erecting shop are connected by two direct tracks and two others lead into the tender truck repair shop. A separate track goes to the boiler and tank shop, which can also be entered by two tracks at the east end. The blacksmith shop and erecting shop are joined by a board path over which electric storage battery trucks are operated and there is also a standard gage track extending from under the 50-ton gantry crane runway to the track through the center of the shop.

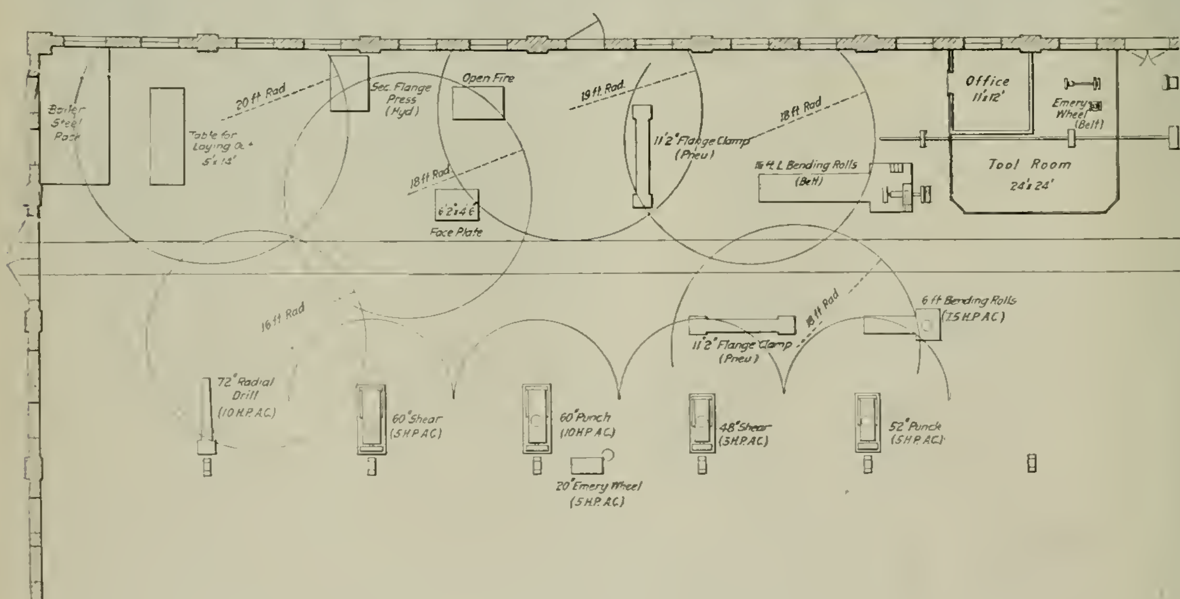
One of the things that frequently causes trouble in railroad shops is local congestion due to the inability to predetermine accurately how much room will be required by each department. In this instance, space has been left between most of the departments. This gives extra floor area for the material and provides leeway for future growth. The extra space has been apportioned with considerable judgment, for instance, it seems likely that the number of stoker fired engines will increase and therefore the stoker department has been allowed room to grow. On the other hand, the work on eccentrics and straps is handled in the smallest possible area because these parts are not found on modern locomotives. While no enlargement to the shop is planned further extensions toward the west or toward the north are quite feasible.

Ease of observation, important as an aid to supervision, has been given due consideration. The longitudinal arrangement of the pits in the erecting shop enables the foreman to see work being done on several engines from any point. By grouping the tools in the machine shop in single rows with a passageway between, the same object has been accomplished.

SHOP OPERATION.

ERECTING SHOP.

Locomotives awaiting repairs are stored on dead tracks in the yard east of the shops. They enter the erecting shop at the east end where the stripping is carried on. When the stripping is finished the locomotive is set on blocks in the center portion of the shop. If it is necessary to remove the boiler, this is placed on a car and taken to the boiler shop. Flues are cut out, placed on push cars and run to the flue shop. The wheels and driving boxes are rolled out under the 50-ton gantry crane, which takes them to the lye vat. The pedestal binders crossheads, links, hangers and similar parts are placed in containers to facilitate the cleaning. The front ends are stored in a rack adjoining the finishing pits.



Plan of Boiler Shop, Showing Location of Machine Tools.

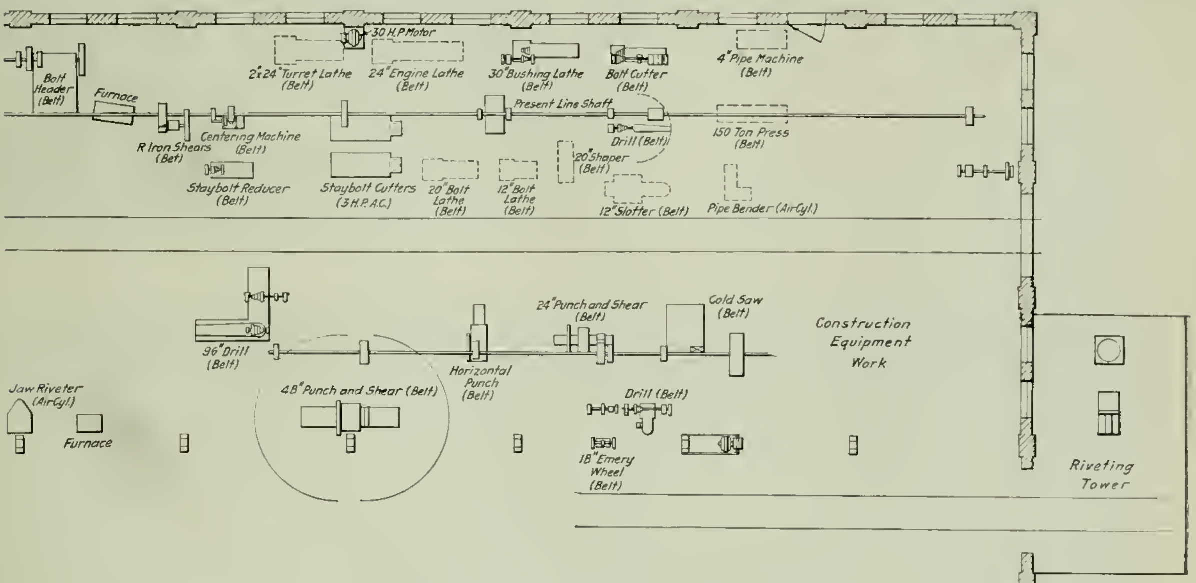
HEAVY MACHINE BAY.

Driving Wheels, Axles and Crank Pins.—The driving wheel department is at the extreme eastern end of the machine shop. From the lye vat the wheels are rolled in on a stub track and inspected. If the wheel centers need to be pressed off or crank pins pressed out, they go to a 600-ton wheel press on the left hand side. Beyond the press are located the axle lathe, crank pin lathe, and quartering machine. On the right hand side of the track are the stands for holding wheels while the tires are removed or set. The tires on truck wheels are removed and applied in this department, as there is not enough of such work to justify the duplication of the facilities. Beyond the mounting stands are located the boring mill for wheel centers and tires, a driving wheel lathe and a journal turning lathe. Next in order come the tracks adjoining the fitting bench where hub plates are applied and crank pins trued up. The eccentric cranks and eccentrics are fitted on a track next to the eccentric bench, and also adjacent to the driving box department. Wheels are fitted with driving boxes and cellars before they go to the erecting shop. There are 16 tracks for storing wheels, each 35 ft. long, and extending out into the erecting bay to facilitate handling.

Eccentric Department.—The eccentrics and straps are brought from the lye vat to the eccentric department which has a 36-in. Bullard vertical turret lathe, used mostly for turning up brass liners, and a Gisholt 42-in. boring mill used for eccentrics and straps.

Driving Boxes.—The boxes from the lye vat are placed on a platform south of the passage through the machine shop, where they are inspected. Those requiring new crown brasses go to the press, while others are taken to the planer. The crown brasses are shaped on the slotter and then pressed in. The box then follows the same course as those not requiring brasses, going to the planer to be faced on the shoe and wedge fit, and on the hub if necessary, and then to the boring mill. After being bored a clearance for the grease is cut on the back side of the box only on the slotter. The removed. The rods are next examined for cracks. If they need reboring they are sent to the horizontal boring mill. Next they go to the radial drill to have the taper knuckle joint pin fit reamed out, then the pins are fitted. After this operation the rods are set on a rack at the west end of the rod department and the bushings are fitted on a small boring mill. After the bushings are bored and pressed in, the rods are fitted together and trammed for length, being changed by the blacksmith if necessary. Knuckle joint pins and bushings and crosshead pins are turned up rough on a 7½-in. Libby high duty turret lathe. The sides of main rod straps are trued up on the surface grinder and main rod brasses are shaped to size on two 28-in. shapers with special attachments and bored out on a 36-in. Bullard vertical turret lathe. Side rod bushings are pressed in by a 100-ton hydraulic press.

Valve Motion.—The diversity of work involved in the repairing of valve motion makes it difficult to establish a routing for the parts, except in a general way. However, the majority of parts can be finished on one or two machines and as they are relatively light the handling presents no special difficulty. The rocker arms, lift shafts, bushings, valve



Plan of Boiler Shop, Showing Location of Machine Tools.

lateral play of the driving boxes is governed by the thickness of the hub liner on the wheel center. The flanges on each pair of driving boxes are made the same thickness. The man applying the hub plates takes this dimension off the box with the thickness of the shoe and wedge flanges and the distance over the frames and has the brass hub liners turned to the proper thickness to give ⅛ in. lateral clearance. Each half of the hub plate is put on with four wrought iron pins having a straight fit in the wheel center and a counter-sunk head. When the driving boxes are worn down ⅜ in. the face is counter-bored and a ½-in. sheet steel liner is put on with countersunk head bolts.

Shoes and Wedges.—All new shoes and wedges are finished on a planer near the driving box department. When these parts come from the engine after being laid off, they are faced on a planer in the light machine bay near the west end of the shop shown on the layout as No. 70.

Main and Side Rods.—The rods as they come from the locomotive are placed on rails resting on trestles, the main rods on one side and the side rods on another. They are then cleaned with waste, and grease cups and bushings are bodies, rings, etc., are handled on two lathes. Pins are roughed out on Jones and Lamson and Pratt and Whitney turret lathes. Pins are fitted on three lathes, one of 16-in. swing and two with a swing of 18 in. The drilling of heavy parts is done on a Baker high duty drill, while lighter work is handled on drill presses in the light machine bay. A planer in the light machine bay handles surfacing operations on links and similar parts.

Pistons and Rods, Crossheads and Guides.—The piston guide, and crosshead work is done at the extreme west end of the heavy machine bay. The machine tools include a 42-in. Bullard vertical turret lathe for turning piston packing, a 36-in. vertical turret lathe for turning valve chamber heads, packing, etc., a Baker high duty drill for miscellaneous drilling and reaming, two piston lathes and an Acme turret lathe. As the pistons come from the locomotive they are set on the floor and examined. The nuts are turned off in a lathe and the pistons are sent to the 250-ton press and the heads are taken off. The rods then go to one of the two lathes and are trued up or if necessary are replaced with new rods. The piston heads are turned up on a boring mill and come to this department finished except for the cylinder fit. The pistons are put on the rod and the outside is turned and grooved for the packing rings.

Crossheads are set alongside the pistons and rods. The shoes are taken off, and if necessary, the crosshead pin fit and the piston rod fit are reamed. The crosshead shoes go to the babbitt furnace to be relined and when they are returned are applied to the crosshead and the bolts are fitted. Then the complete crosshead goes to the planer where the shoes are planed to fit the guides; after which the crosshead pin is fitted. Then the piston rod is inserted and the key shaped to fit. As the final operation, the gland is fitted on and the packing is bored to size.

Crosshead guides coming from the locomotive are placed on a rack from which they are handled by a jib crane onto the surface grinder. After heing ground on the face and the sides, they are put back in another portion of the rack, until they are ready to be applied to the engine.

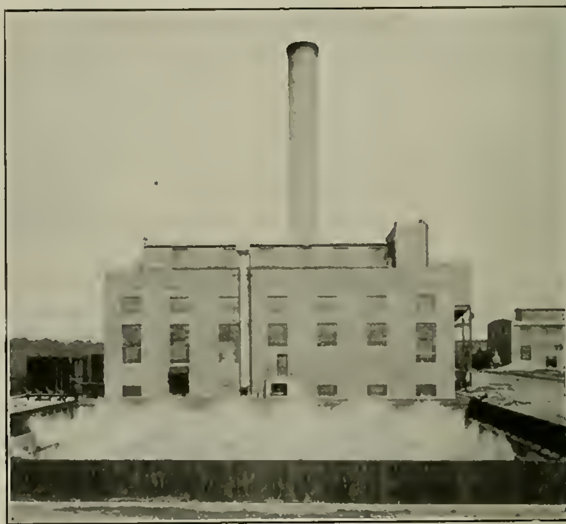
LIGHT MACHINE BAY.

At the extreme east end of the light machine bay the driver brake rigging and spring rigging is repaired. This is largely bench work with the exception of pins and bushings, which are handled on a Warner & Swasey hollow hexagon turret lathe and a Jones & Lamson flat turret lathe. Two engine lathes are used for turning up trunnions, etc., and there are also provided in this department a drill press and a hydraulic bushing press.

Next to the spring rigging department is the air brake department. At the east end air pumps are repaired. Three small engine lathes, a shaper and a drill press are conveniently located to do the work that must be handled on these machines. The lighter air brake parts as well as injectors, lubricators, pops, bell ringers, valves and gages are repaired at benches about half way down the shop. There are three brass lathes and one engine lathe serving this department. Just beyond the brass lathes is the bolt department. In this department there are five turret lathes, seven small engine lathes for fitting helts, a centering machine, a drill press, a nut facer, a 4-in. single spindle tapping machine and a three-spindle bolt cutter.

Tool Room.—The tool room is very completely equipped for light or heavy work. The smaller machines are belt driven from line shafting but the larger lathes have individual motor drive. There are two cylindrical grinders and one universal grinder. For repetition work such as pins, sleeves, sockets, flue rollers, etc., a Warner & Swasey hollow hexagon turret lathe is used. The repairs to speed recorders are handled at a bench with special fixtures in the tool room. Just beyond the tool room are several benches where machine tools, hoists, and similar machinery, are overhauled. In the northwest corner of the tool room is located a light Beaudry hammer and an oil furnace where chisels and other tools are made and put in shape. The main stock room for blue prints and hand tools is in the corner of the tool room. Above this is the foreman's office which gives a view of the entire north side of the shops. The walls are of glass to give a wide field of vision.

The west end of the light machine bay is occupied by the electrical department. Here repairs to headlight equipment,



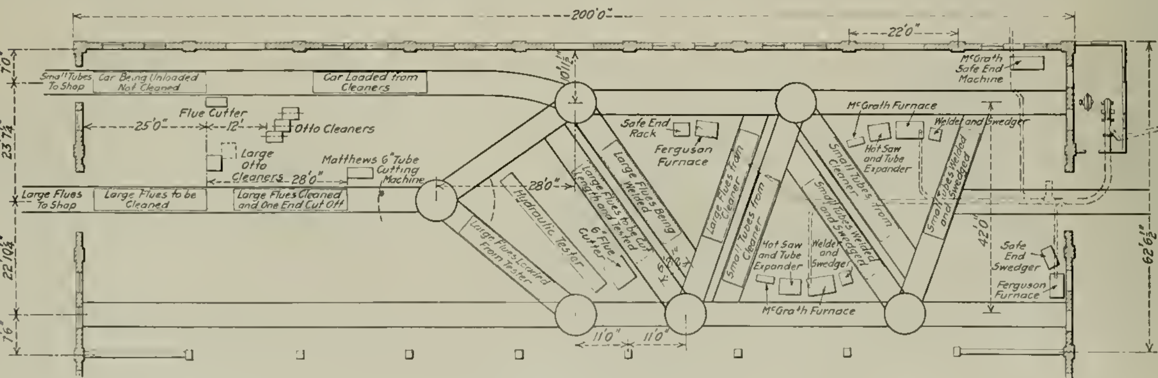
Power Plant and Spray Cooling Pond

motors, gasoline engines and section cars are carried on. A part of the space at this end of the shop is devoted to storage at the present time.

SOUTH BAY.

The large bay south of the erecting shop is equipped to handle the work on frames and cylinders, engine trucks and most of the auxiliary parts of the boiler and the machinery. All the tools in this section have individual motor drive.

Frames and Cylinders.—At the east end of the south bay, alongside the erecting shop, is located equipment for planing and slotting frames, consisting of a 60-in. planer, a double head frame slotter and a 96-in. radial drill. These machines are not kept busy on frame work, so they also handle other heavy parts of a miscellaneous character. The cylinder work is done on a group of machines located along the east end of the south wall in the south bay. This consists of a



Layout of Machines and Tracks in the Flue Shop three-spindle cylinder and valve boring machine, an 84-in. planer with reversing motor drive and a 96-in. radial drill. A notable feature of the work in this department is the extent to which jigs, fixtures and templets are used. Cylinders are finished in considerable numbers and a great deal of time is saved by the device used for lining up the cylinders for planing, which is shown in the illustration, and by the jigs for locating bolt holes not only around the cylinder bore, but also in the frame and saddle fits.

Engine Trucks.—The engine truck department has a

Exterior of the Blacksmith Shop

16-in. engine lathe for bolt work, a 42-in. lathe for truing journals, a Sellers 48-in. car wheel lathe driven by a 50-h. p. direct current motor, and a 400-ton wheel press.

Ashpans.—The ashpan department is equipped with a punch and shear besides numerous pneumatic tools. Adjacent to this department there is a sub-store for bolts, nuts, washers, rivets, etc.

Steam Pipes.—As the repairs of steam pipes, dry pipes and throttle valves and superheater headers is largely bench work, this department has but one machine tool, an Acme turret lathe, used for finishing dry pipe rings and similar work. There are a large number of ingenious fixtures used in grinding joints with air motors.

Stokers.—A considerable amount of space is devoted to stoker work, but as the majority of these parts are maintained to standard sizes, the machine work required is handled in other departments. The stoker engines are overhauled here and are tested before being installed on the locomotive.

Piping and Superheater Units.—The steam and air brake piping and superheater units are handled in the same department. The piping as it comes from the locomotives is thoroughly cleaned in the lye vats and is then placed on racks.

Cab and Upholstery Work.—The cabs used by the C. B. & Q. are mostly of wood with a steel front. To take care of the repairing a small wood working department has been installed at the west end of the shop. Here the cabs and seat boxes are overhauled.

Paint Shop.—A small stucco building north of the erecting and machine shop is used for the storage of paint and also for reworking boiler lagging. Another similar structure near the lye vat is used for reclaiming journal box packing and driving box grease.

BLACKSMITH SHOP.

The blacksmith shop is well equipped to handle heavy or light hammer work, general blacksmithing and bolt making. The heaviest steam hammer is one of 5,000-lb. capacity, with a double frame, which is used principally for making billets from scrap iron. Short pieces of bolts and flat bars are piled on boards and brought to a welding heat in the scrap furnaces and are then shaped into slabs under the steam hammer. These slabs are again piled together and made into billets. Iron of excellent quality is secured in this way. In addition to the 5,000-lb. hammer there is one of 3,000-lb., one of 1,600-lb., five of 1,500-lb., and two of 650-lb.

For making parts in considerable quantity there is a battery of Bradley hammers, including three 500-lb. and one 60-lb. size, a large bulldozer and one 3-in. and two 1½-in. forging machines. The Bradley hammers and forging machines are belt driven from a line shaft, while the bulldozer, punches and shears are direct connected. At the south end of the shop there is a small pneumatic hammer on which tools are dressed. The shop is well equipped with light and heavy jib cranes to facilitate the handling of the work. It is also equipped throughout with oil furnaces. The blast is furnished from two high pressure direct connected electric

Interior of the Flue Shop

driven blowers, each one of ample capacity to handle the entire shop equipment. The shop is also equipped with sanitary closets and washrooms for the convenience of the men.

POWER PLANT.

The power house supplies steam, compressed air and electric current for the entire plant and is equipped to raise the pressure on the water mains in case of fire. There is no high pressure pump for hydraulic apparatus, however, as all machines operated by hydraulic power have individual motor drive. This arrangement was considered more satisfactory since it eliminated the necessity for a line of high-pressure piping, which is often troublesome to maintain. The boiler room has six Murray Iron Works water tube boilers of 400 h. p. each, equipped with Foster superheaters and Taylor underfeed stokers. Space has been provided for four additional boilers. A boiler pressure of 150 lb. is maintained and the steam is superheated to 500 deg. F. A 4,000-h. p. Webster Star open type feed water heater is installed on a platform in the boiler room and an Alberger condenser in the basement under the engineroom. A spray pond of 500,000 gal. capacity, located 75 ft. west of the power plant, is used in connection with condensing apparatus.

The coal is dumped into a hopper underneath the track and is carried by a chain bucket type elevator into a conveyor that delivers it into overhead bunkers, where the coal is measured before being fed to the mechanical stokers. The ashes are collected in hoppers under the furnaces and are dumped into an ash car which carries them to the elevator pit. The elevator raises them to an overhead ash bin from which they are dumped into the empty coal car. The smoke stack is of brick, 12 ft. in diameter and 150 ft. high. Forced draft is supplied by three blowers driven by steam engines. The boiler room equipment operates non-condensing to supply the steam for feed water heating.

The electric generating equipment consists of two 750 kw. General Electric high pressure turbo generators, producing three-phase current at 440 volts and 60 cycles. The turbines are of the bleeder type, so-called from the fact that steam for heating is drawn off at a pressure of 4 to 5 lb., after passing the first stage of the turbine. A vacuum of 27½ in. of mercury is carried on the low pressure stage. To furnish direct current for the variable speed shop motors there are two 200-kw. motor generator sets, generating at 220 volts d. c. There is one steam turbine driven and one motor driven exciter. A central switch board is installed on the west wall of the engine room and an instrument board for the boilers is located on the east wall. These carry a very complete equipment of pressure and temperature gages and draft gages and also continuous CO_2 recorder for each boiler. A Venturi meter is used for checking the amount of water evaporated by the boilers.

There are two air compressors in the turbine room both operating at a pressure of 110 lb. per sq. in. One is an Ingersoll compound type of 1,350 cu. ft. per minute capacity, taken from the old power house. The other is a Laidlaw condensing cross compound high duty compressor, with a capacity of 3,650 cu. ft. of free air at 110 R. P. M. The fire pump is a Fairbanks-Morse, 18 in. by 10 in. by 12 in. underwriters pump having a capacity of 1,000 gal. per minute. The steam, air and electric lines are carried from the power house to the shop in a concrete tunnel.

The engine room is equipped with a ten-ton traveling hand crane which spans the whole width of the building. This crane is used to facilitate handling or repairs to equipment.

BOILER SHOP.

The boiler shop is located in the building formerly used as the machine and erecting shop. The boilers are placed on the south side, which is equipped with overhead cranes across the three longitudinal tracks. The machines are on the north side and are served by a monorail floor crane. The west end of the machine department is devoted to heavy plate work. Here are located the laying out table, bending rolls and flange fire, as well as the heavy punches and shears. At the center of the north wall is the office and tool room. In the space east of this the light machines, such as bolt cutters, lathes and small drill presses are located. Some of the tank work is being handled in the boiler shop, but eventually all the tender tank and truck work will be taken care of in the south half of the old boiler shop, just west of the present boiler shop.

FLUE SHOP.

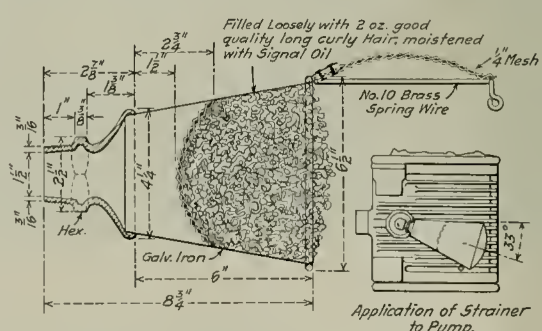
A unique arrangement of machines and tracks is used in the department where the tubes and flues are repaired. The layout of the shop is shown in the illustration below. Small flues after being removed from the boiler are loaded on push cars and enter the shop on the north track. The back end is cut off square and the flue is run through one of the Otto cleaners to remove the scale. As the tubes pass out from the cleaners they are placed on another push car. The clean tubes go down the track to the second turn table and are set on one of two diagonal tracks leading from it. Adjoining each of these tracks is the equipment necessary for applying safe ends, consisting of a small oil furnace, a hot saw and tube expander, a welding furnace and a welder and swedger. The flues pass through the furnaces and machines and when completed are placed on push cars on one of the diagonal tracks leading to the transverse track on the south side. The front ends of the tubes are heated with an oil burner to anneal them and they are cut to length and sent to the erecting shop to be reapplied.

Superheater flues are handled in a similar manner. The push cars enter the shop by the center track. The flues are cleaned and the back end is cut off, and the car is then set on the diagonal track next to the furnace. The safe end is inserted in the furnace but not welded, being swedged down to enter the flue for a distance of about one inch and welded to the flue with the oxy-acetylene torch. After the flues have had safe ends welded on they are cut to length and tested and are then annealed and put back in the boiler.

AIR PUMP STRAINER

BY E. A. M.

A simple air pump strainer, much more effective than the ordinary type which has so long been used, is shown in the drawing. In making it the casting from the old type strainer



A Simple Curled Hair Air Pump Strainer

is used, and in this is inserted a cone-shaped tube of sheet metal 6 in. long by 6½ in. outside diameter at the large end. A concave screen of ¼-in. wire mesh is inserted in the tube and soldered in place 2¾ in. from the inner end. The remainder of the strainer is loosely filled with curled hair, about two ounces being required for this purpose. The outer end of the strainer is closed with a hinged lid of 1/4-in. wire mesh, soldered to a light brass wire frame. A slot in the side of the tube is provided to take the latch formed on the end of the wire lid frame. In order to provide sufficient spring for the proper operation of the latch, about two inches of the frame at the latch end of the wire is left unattached to the netting. The lid is hinged to the strainer at a point opposite the latch.

PRESENT CONDITION OF LOCOMOTIVES AND CARS

Notwithstanding the fact that the number of locomotives actually built for the use of the railways in the United States during the past year and the four preceding years has materially fallen behind the 10-year average of 1907 to 1917 inclusive, and that there was an acute shortage of power apparent at the close of 1917, there is at the present time very little evidence of a lack of sufficient power to meet immediate requirements. This does not mean, however, that there is no need for new power. Old locomotives have been kept in service at a sacrifice in operating efficiency to preclude a repetition of conditions existing last winter. The number of locomotives built each year during the above-mentioned 10-year period for domestic steam railroad use has averaged approximately 3,300. For the past five years, beginning with 1914, the railroads have fallen behind this figure by an average of about 1,300 locomotives each year, a decrease which can be accounted for only partially by the increase in tractive effort of the locomotives built during recent years.

Aside from the fact that the unprecedented weather conditions of last winter, so far have not been repeated this season, the present fortunate situation is broadly attributable to three factors: (1) In general the power of the country is in much better condition now than at the beginning of any winter for several years past; (2) the application of economy and capacity increasing devices to existing equipment has increased the effectiveness for service of a large number of locomotives, and, (3) there are now retained in service many locomotives which, if new power were available, would and could economically be scrapped.

LOCOMOTIVES IN GOOD CONDITION

That the condition of power is much better than it was last year is evidenced by the fact that for several months past there have constantly been stored in serviceable condition from 800 to 1,000 locomotives, over half of them on the eastern roads, where extraordinary demands are most apt to arise. This improvement has been made possible by the increased working hours which have been in effect since last spring, the decrease in labor turnover during the latter part of the year, and the increase in the number of men employed on locomotive maintenance. Both of the latter are the result of the wage increases put into effect by the Railroad Administration.

Table I—Weekly Summary of the Condition of Power on the Railroads Operated by the United States Railroad Administration

Week ending	Number of locomotives: On lines	Number of locomotives: Serviceable	Number of locomotives: In or awaiting shops	Per cent of locomotives out of service for over 24 hours	Number of locomotives turned out of shops: 1918	1917	Increase	Number of locomotives: Being repaired for other lines	Number of locomotives: Stored serviceable	Number of employees in locomotive department: 1918	1917	Increase
August 3.........	62,764	53,665	9,999	14.4	5,329	4,462	867	190	924	261,915	241,104	20,811
August 17........	62,740	53,398	9,342	14.8	5,260	4,337	923	177	708	262,056	240,615	21,441
August 31........	62,908	53,932	8,974	14.2	5,828	4,940	888	194	848	264,349	241,845	22,504
September 14.....	63,119	53,774	9,345	14.8	5,686	4,507	1,179	199	994	273,752	245,996	27,756
September 28.....	63,126	53,987	9,139	14.4	6,083	4,806	1,277	236	913	275,326	247,533	27,793
October 12.......	63,162	53,874	9,288	14.7	5,576	4,599	977	245	901	270,287	249,543	20,744
October 26.......	63,247	53,711	9,536	15 0	5.807	4,723	1,084	274	875	271,554	250,195	21,359
November 9......	63,269	53,357	9,912	15.6	5,791	4,636	1,155	284	878	276,837	253.066	23,771
November 30.....	63,418	53,641	9,777	15.4	6,317	5,054	1,263	259	1,119	281,384	253,788	27,596

What has been accomplished in increased shop output will be evident from an inspection of Table 1*, showing the condition of power for alternate weeks during a period of 18 weeks, for the months of August to November inclusive, which has been compiled from data collected by the equipment maintenance section of the Division of Operation of the Railroad Administration. For this period, which is practically one-third of the year, it is evident that the number of locomotives turned out of shops (including all engines out of service for repairs over 24 hours) is nearly 23 per cent greater than during the corresponding period of 1917, while the number of employees in the locomotive department has been approximately 9 per cent to 11 per cent greater than the number in service last year. Taking the country as a whole, the increase in output is more than accounted for by the increase in maintenance forces and the increase in working hours from the eight, nine and ten-hour days in effect in various parts of the country, to the 70-hour week, which was in effect on many roads from March to November 25. During the period covered by the table it also will be seen that there has been a gradual increase in the number of locomotives being repaired for other lines, the maximum shown being 284 during the first week in November.

Since November 25, when working time was reduced from 70 hours a week to a nine-hour day basis, followed on December 9 by a further reduction to an eight-hour day, there has been a decrease in output which has been felt more particularly in running repairs. The eight-hour day necessitates the employment of three shifts at engine terminals, with a consequent increase in supervision, where two shifts have heretofore been the rule. At present, in most cases practically the same number of men who have constituted the two shifts must be redivided into three. It will, of course, be possible gradually to build up these forces to overcome the present shortage as demobilization progresses. The power has been put in such good condition during the past summer and fall that the reduction in back shop output following the reduced number of working hours on the whole need give little immediate concern.

Since 1914, the conditions which have restricted the buying of new power have directed attention to the possibilities for increasing the capacity of a large number of existing locomotives by the application of economy and capacity increasing devices, most important of which are the superheater, mechanical stoker and brick arch. During the past four years not less than 10,000 old locomotives have been equipped with one or more of these devices. In some cases the conversion has made unnecessary the purchase of a new class of power to perform the service which these engines were becoming unsuitable for, but which they are now capable of performing satisfactorily. In such cases each converted locomotive has saved the purchase of a new one, while in others the saving in new locomotives has been in proportion to the increase in capacity effected by the change, which

*A detail report of the condition of power by regions for the week ending September 28, 1918, was published in the *Railway Mechanical Engineer* for November, page 605.

conservatively would be between 10 and 20 per cent. It is evident that these 10,000 converted locomotives have had a material influence in preventing an acute power shortage.

While the use of obsolete locomotives, to scrap which authorization has been secured or is contemplated, may be effective in preventing an acute shortage of power, it can be justified only to meet an emergency. With such locomotives in service it cannot truly be said that there is no shortage of power. In the interest of economical operation it is now imperative that there be a heavy purchase of new power in order that the three or four years' accumulation of scrap power may be gotten off the lines.

NO IMPROVEMENT IN FREIGHT CAR CONDITIONS

Although there has been some improvement in the percentage of bad order cars in the course of the year, it is doubtful if there has been any real improvement in the condition of freight cars such as noted in connection with locomotives. In the first place the number of new cars delivered to the railroads during the past year was less than half the number which were placed in service during 1917, and is hardly large enough to take care of normal replacements. The extreme need of equipment during the past year has therefore led to the retaining in service of a large number of cars which should be and will be retired at the first opportunity. These cars, unlike old locomotives, cannot be kept in condition to remain in service without causing an undue proportion of failures, and the need of retirement is therefore greater than in the case of motive power.

Those roads which had practically completed extensive reinforcement programs prior to our entrance into the war still have their equipment in excellent condition. Many roads, however, were only instituting such programs or had only partially carried them out before the pooling of equipment took the rolling stock out of the control of the owning roads. In such cases there has been very little opportunity during the past year to continue the betterment program, the proportion of cars on home roads being so small as to very seriously slow up this work.

The pooling of equipment has also tended to decrease the output of running repairs. It is a comparatively simple matter to supply material for the repairing of home line cars at outlying points where mill facilities are not available. Considerable delay is inevitable, however, where a very large percentage of the cars on the repair tracks belong to foreign lines, each requiring more or less special material.

Table II—Weekly Reports of Car Conditions for All Regions

Week ending	Oct. 19	Oct. 26	Nov. 2	Nov. 9	Nov. 16	Nov. 23
Number of roads reporting	139	139	138	139	139	139
Total revenue cars	2,478,704	2,441,111	2,434,255	2,437,344	2,430,606	2,447,922
Bad order cars—1918	140,328	139,548	135,462	134,874	132,853	130,048
Bad order cars—1917	131,036	132,501	128,957	129,414	124,162	123,056
Heavy repairs—1918	82,459	82,078	79,559	79,198	77,966	78,941
Light repairs—1918	57,869	57,470	55,903	55,676	54,887	51,107
Percentage of bad order cars	5.7	5.7	5.6	5.6	5.5	5.3
Average number of bad order cars repaired per working day	86,486	83,279	83,328	83,469	82,274	82,805
Heavy repairs	9,332	8,871	8,578	8,797	8,173	8,209
Light repairs	77,154	74,408	74,750	74,672	74,101	74,596
Number of cars transferred to other shops	5,075	626	589	253	485	524
Number of employees—1918	140,021	138,703	158,959	142,500	141,540	143,169
Number of employees—1917	118,758	123,156	124,256	124,521	123,966	124,319
Number of cars damaged in trains	13,605	13,060	12,446	12,364	12,255	12,668
Cost of labor	$126,630	$121,275	$90,464	$122,463	$128,925	$135,887
Cost of material	$154,708	$151,476	$170,532	$162,818	$179,972	$182,005
Number of cars damaged in yards	5,264	4,868	5,267	5,275	5,159	5,242
Cost of labor	$54,308	$46,823	$53,492	$49,959	$50,886	$52,406
Cost of material	$76,589	$61,135	$68,072	$66,920	$93,720	$70,987
Cars held to be dismantled	5,584	7,211	6,920	6,823	6,646	6,640

The destruction of the incentive of the pieceworker following the failure to adjust the piecework wage differential to correspond to the increase in hourly rates, has had a much more marked effect in reducing the output in the car department than it has in the locomotive department.

The effect of these adverse conditions is not reflected in the percentage of bad order cars, which has been maintained between 5 and 6 per cent, a figure approximately equal to the average for the country in 1917. An inspection of Table II*, however, shows that of the total number of bad order cars shown on the weekly statements of the maintenance of equipment section of the Division of Operation of the Railroad Administration for the six weeks ending November 23, from 58.7 per cent to 60.7 per cent are classed as needing heavy repairs. Of the corresponding daily output the number of heavy repairs has averaged a fraction above 10 per cent. It is evident, therefore, that there is an accumulation of cars needing heavy repairs, which eventually must be reckoned with. If this situation is to be improved some means should be taken to return the cars to the owning roads at the earliest possible opportunity, where in many cases material for reinforcing is already available, as in this way only can the greatest output be obtained for the labor expended.

Table III—Percentage of Bad Order Cars by Regions

Week	Oct. 19	Oct. 26	Nov. 2	Nov. 9	Nov. 16	Nov. 23
Eastern	6.3	6.4	6.2	6.3	6.1	6.1
Allegheny	7.1	7.1	7.1	7.0	6.7	6.4
Pocahontas	5.9	6.9	5.8	5.6	5.6	5.1
Southern	4.4	4.8	4.5	4.7	4.8	4.4
Central Western	5.0	4.9	4.7	4.8	4.8	4.7
South Western	3.1	3.1	2.9	2.9	2.8	2.8
North Western	5.7	5.4	5.4	5.2	5.3	5.2
All regions	5.7	5.7	5.6	5.6	5.5	5.3

Air brake conditions have been notably poor during the past year. This is due in part to a lack of proper facilities for testing and repairing brake equipment, to the necessity for employing many inexperienced men on this class of maintenance, and in part to a shortage of material.

Efficiency of Oxy-Acetylene Welds.—It has been proved in tests on boiler plate that the average oxy-acetylene weld has an efficiency in the neighborhood of 70 per cent, although tests have been made in which the efficiency has run much higher. This would be a fair comparison with a lap-double seam of the ordinary 44,000 lb. shear of rivets, using a tensile strength of 55,000 lb. for the plate.—*The Engineer, London.*

Record Claimed for Oxy-Acetylene Torch Cutting Out Rivets.—An operator employed by the Submarine Boat Corporation, Newark, N. J., claims a record, which was witnessed, timed and sworn to, of having cut out with his oxy-acetylene torch 123 3-inch countersunk rivets from an oil tank cover in 55 minutes. The work was so well done that the rivets came out with one stroke of the maul and punch. —*American Machinist.*

*For tables showing car conditions since the middle of July, see the *Railway Mechanical Engineer* for November, page 614, and December, page 656.

Our Railway War Forces Abroad

An Account of the Problems Encountered in France and the Shop Facilities for Erecting Equipment

THE January 3 issue of Railway Age contains a signed article by Samuel O. Dunn, editor of that paper, which gives the first account of what the Transportation Department of the A. E. F. has done since America entered the war. Mr. Dunn, who has just returned from England and France, was the first American press representative to visit Tours, the headquarters of the Transportation Corps, since the signing of the armistice. He was given full access to all sources of information as to what has been accomplished by

Repairing Locomotives at Nevers

our American railway men. The following, which is of particular interest to our readers, is taken from that article:

When the United States entered the war in April, 1917, the officers and employees of American railways knew extremely little—in fact, practically all of them knew next to nothing—about the way in which the railways of Europe were constructed, equipped and operated. Even as late as July, 1917, the transportation department was practically non-existent. One year later—in June, 1918—it had a personnel of 1,300 officers and 30,000 men, was operating

Locomotive Shops at Nevers

through eleven French ports, and over an extensive system of railways and inland waterways. It was running exclusively American trains, the first train which was exclusively American in equipment and personnel having been run on July 1, 1918, from Gievre to Nevers, a distance of 83 miles. When the armistice was signed, in November, 1918, the American Transportation Corps had a personnel of 1,970 officers and 53,136 enlisted men. In addition, 553 officers and 21,452 men were attached to it for duty, making a total personnel of 2,523 officers and 73,588 men.

What our railway men have done is to take over the operation, and maintain and enlarge the facilities of existing French railways to the extent necessary, first, to move our own armies and supplies to the front, and, second, to enable the French army to continue to carry on its part of the struggle with unimpaired energy and effectiveness. In order to enable the French railways to handle the vast additional traffic, it was necessary greatly to enlarge the facilities of the railways by building second, third and fourth tracks in some places; by building cut-offs in other places; by constructing numerous large yards and vast storehouses; by building shops to erect and maintain locomotives and cars, and by importing and putting in service large quantities of railway equipment and materials. Over 300 large construction projects (to be exact 316) were undertaken for the Transportation Corps. The total number of miles of new trackage actually built was 937, and the number of cars shipped from the United States knocked down and erected in France up to December 12, was 15,068. The number of locomotives from the United States put in service by our military forces in France was 1,105. Up to December 12 the complete record

Locomotive Repair Shop at Nevers

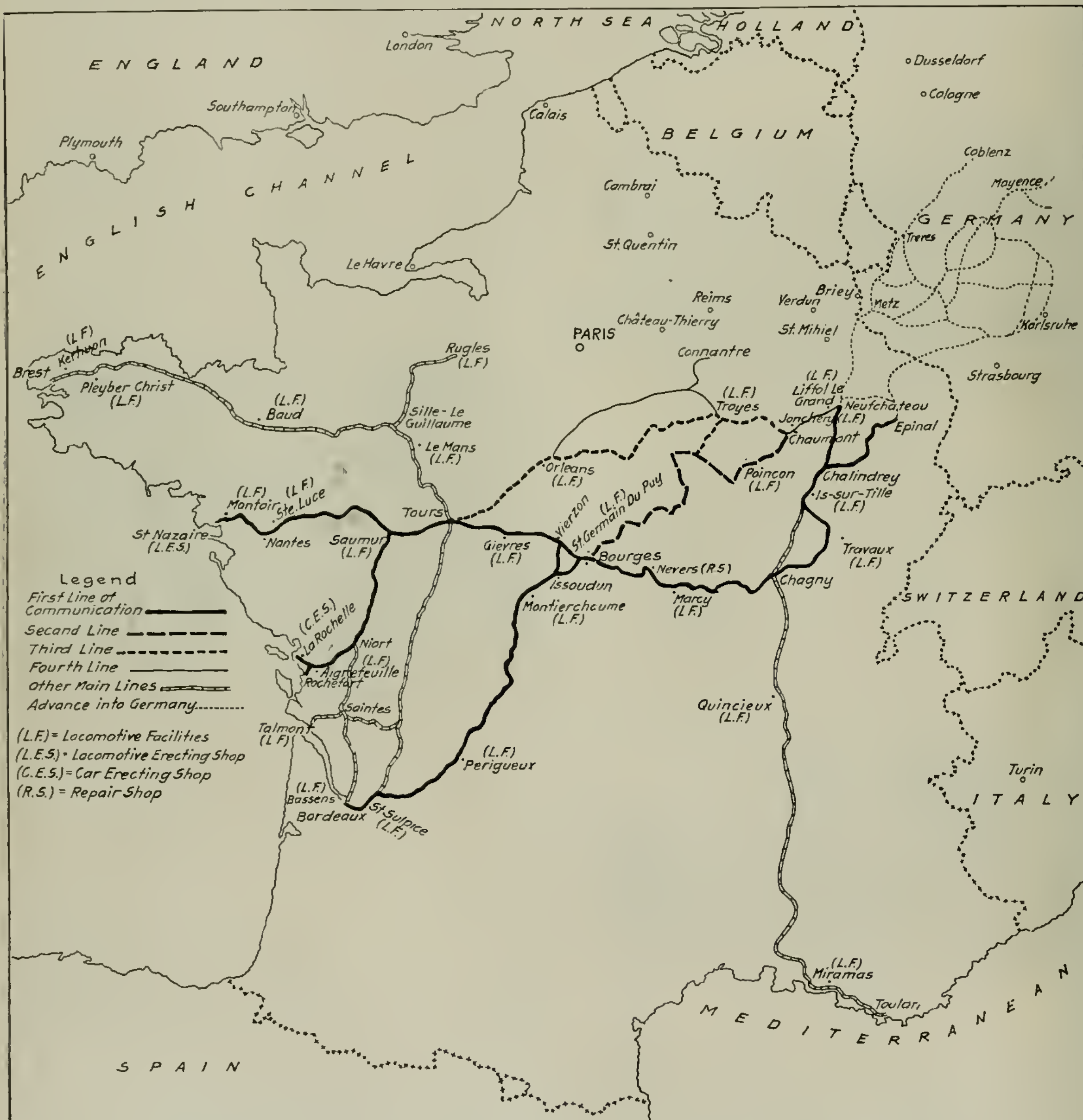
of the Transportation Corps with respect to the ordering, acquisition and erection of locomotives and cars was as follows:

	Locomotives			Freight cars		
	From U. S.	Other sources	Total	From U. S.	Other sources	Total
No. ordered	1,600	425	2,025	30,000	1,040	31,040
On sea	34	...	34	400	...	400
At port	139	...	139	747	...	747
At shop for erection...	19	63	82	1,238	...	1,238
Erected today (Dec. 12)	8	...	8	80	...	80
Erected to date	1,105	336	1,441	15,068	988	16,056

The magnitude of the work which the Transportation Corps has done is indicated, although only partially indicated, by the tonnage of supplies and the number of soldiers it has handled. Between June 1, 1917, and November 30, 1918, the total tonnage of supplies moved for the American Expeditionary Forces was 6,547,621 tons. What was accomplished is much better indicated by the increase in the tonnage handled per month and per day. In June, 1917, the tonnage handled was 24,524, or 817 tons per day, while in November, 1918, the tonnage handled was 920,972, or 30,699 tons per day. Plans had been made and were being carried out for providing a transportation capacity of 101,000 tons a day by June, 1919, if the war lasted until then. In the eighteen months from June, 1917, to November, 1918, inclusive, the number of troops transported into France was 1,865,440, and the number of animals, 53,117.

In the early part of August, 1917, General Pershing established the principle that there must at all times be kept on hand in France 90 days' supplies of all kinds for our troops. Forty-five days' supply must be available at base ports; 30 days' supply at intermediate storage points, and 15 days' supply at advance storage points, which were to be 50 or 60 miles from the front.

It was originally estimated that, on the average, there would have to be provided and transported 100 pounds of supplies daily for every American soldier in France. Ex-



Lines of Communication, American Expeditionary Forces. Light Dotted Lines Show Advance Into Germany

perience showed that this estimate was much too large, and later ones were based on an average requirement of 50 pounds per day per man. The actual consumption, after the army had become large, was about 40 pounds per man per day.

As the number of Americans in France and the amount of supplies which had to be furnished them increased by leaps and bounds, it became necessary rapidly to increase the number of ports used and greatly to enlarge the facilities of many of them. Five entire groups of ports finally were used. These were as follows:

Channel Group.—Le Havre, Fecamp, Hornfleur, Rouen, Cherbourg, St. Malo, Granville.

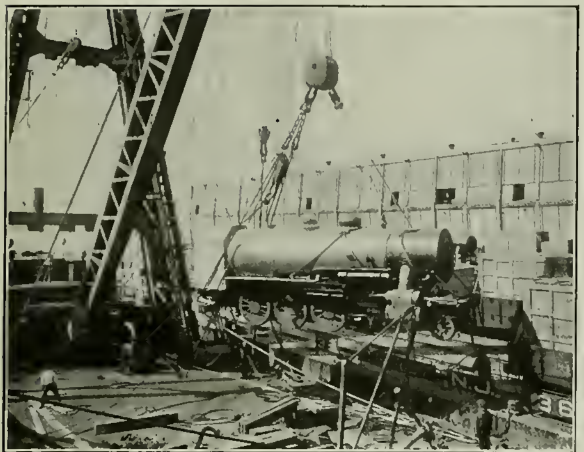
Brest Group.—Brest, Lorient, St. Brieuc.

Loire River Group.—St. Nazaire, Montoir, Donges, Usine Brulee, Nantes, Les Sables d'Alone, La Pallice, Rochefort, La Rochelle, Ponnay-Charente, Marans.

Gironde River Group.—Bordeaux, Pauillac, Blazefort, St. Loubes, American Bassens, French Bassens, St. Sulpice, St. Pardon, Bayonne.

Mediterranean Group.—Marseilles, Toulon, Cette.

The principal dock project was at American Bassens, near Bordeaux. The docks at this point consist of 10 berths of 410 feet each, served by four tracks along the front of the docks. Electric gantry cranes are used for unloading cargoes from ships and placing the supplies on cars. Immediately back of the docks are classification yards and warehouses. There is at present a covered storage capacity of 121,984 square feet and open storage capacity of 262,170 square feet.



Hoisting Locomotive from Lighter to Ship

The tonnage unloaded at the ports in November was divided among the various classes of supplies as follows:

Supplies	Tonnage	Per cent of total
Coal	207,644	22.55
Forage	68,154	7.40
Foods	177,791	19.30
Clothing	9,451	1.03
Oil	23,629	2.51
Other quartermasters' supplies	63,657	6.91
Transportation materials	89,721	9.74
Motor transportation	50,096	5.44
Engineering supplies	75,272	8.17
Ordnance	64,195	6.97
Medical	10,973	1.19
Signal Corps	3,114	.34
Air Service	9,166	1.00
Gas Service	2,883	.31
Troop property	993	.11
Red Cross	3,765	.30
Y. M. C. A.	2,148	.23
Naval	1,780	.19
Steel billets	54,379	5.91
Miscellaneous	3,161	.34
Totals	920,972	100.00

"Ordnance" in the above classification embraces munitions of all kinds; and it is a striking fact that ordnance constituted less than 7 per cent of the supplies transported. Of course, however, a vast work of transportation was carried on in the United States in handling the fuel and raw materials which were used in the manufacture of the ordnance which ultimately formed so small a part of the supplies unloaded and transported in France.

CAR AND LOCOMOTIVE SHOP FACILITIES

Besides providing facilities for taking care of both French and American equipment when it was in service, it was necessary for the Amercan Transportation Department to provide shops for getting it ready to put into service after it was received in France. The erection of locomotives and cars from the United States and the repair of those in France and Belgium by our transportation forces were begun in December, 1917. From that time up to the middle of December, 1918, the shop troops erected 1,055 locomotives from the United States, 99 for the French, and inspected and overhauled 359 from Belgium. They had also repaired 1,423 French locomotives. Records for the same period showed that 14,302 cars from the United Sates and 975 from other sources were erected, and that 45,993 were repaired for the French.

The large locomotive shop, where most of the work on locomotives is done, is at St. Nazaire. Locomotives for overseas shipment are erected and tested in the United States and then knocked down or partially knocked down for shipment. The knocked down locomotives are crated in sixteen boxes, the largest of which weighs 33,000 pounds. The partially knocked down locomotives are complete except rods, cab, stack, piping and odd fittings.

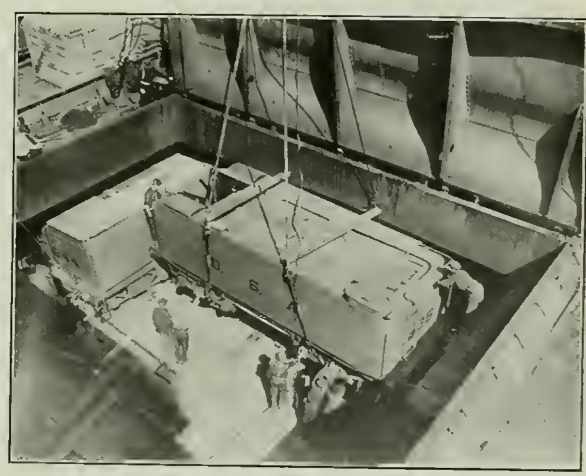
Arrangements were made to rent ten locomotive emplacements in Shop No. 1 from the Societe Anonyme des Ateliers et Chantiers de la Loire, nine emplacements in Shop No. 2 from the Societe Anonyme des Chantiers et Ateliers de Saint Nazaire (Penhouet) and the necessary storage and shifting tracks, all the above being located on the Bassin de Penhouet at St. Nazaire.

The main storage tracks located at Shop No. 1 include 14,600 feet of shifting and storage tracks and embrace 54,500 square feet of locomotive box storage. At Shop No. 2 the yard includes only 2,080 feet of track with no box storage, this yard being used principally for shifting.

The locomotive boxes are unloaded from the vessels by use of the French Titan cranes, loaded on flat cars and shifted to the locomotive box storage yard, unloaded by a 35-ton locomotive crane, and sorted out into complete locomotives, or held until the complete sixteen boxes are available. When sorted properly they are again loaded on flat cars, seven cars to a locomotive, and shifted either to Shop No. 1, close at hand, or Shop No. 2.

The locomotives under erection are handled in the French shops by two 100-ton electric cranes and are erected in proper sequence, that is, the drivers are placed, then the frames, the boiler, etc., until the locomotive is completed and ready to be sent to Montoir engine facilities to be tested.

The first locomotive was turned out at St. Nazaire shops October 27, 1917. Since that time, up to and including December 12, 1918, 1,032 locomotives have been completed.



Locomotive Tenders in Hold of Ship

This does not include 30 smaller type saddle tank locomotives completed at Rennes. The maximum daily output was obtained on September 6, when 14 locomotives were completed, this number consisting of seven partially erected type and seven knocked down type. The maximum weekly total was obtained during the week September 1 to 7, 1918, and was 69 locomotives. This number included 39 partially erected type and 29 knocked down type, and one saddle tank locomotive. The maximum monthly total was obtained in

September, 1918, and was 215 locomotives, 77 partially erected, 137 knocked down, and one saddle tank.

It is estimated that erecting shops No. 1 and No. 2 are capable of an output of 300 locomotives per month, 200 knocked down, and 100 partially erected. This capacity was never realized, as the locomotives were not received from the States in sufficient numbers, or were held up in ports.

When it was first proposed by the Transportation Department that locomotives should be shipped to Europe only partially knocked down, the Shipbuilding Board protested upon the ground that no ships were in existence which could stand up under the strain of such an immense concerted load. But boats were found which would stand up; and as many as 12 to 15 partially knocked down locomotives, together with their tenders, have been shipped to Europe in a single ship. This method of shipment has saved time and labor on both sides of the Atlantic, but especially after the engines have arrived in Europe. Gantry cranes which have been erected both at Bordeaux and St. Nazaire, have been used in transferring locomotives from the ships to the docks.

The large car erecting shops are at La Rochelle. These shops cover an approximate total area of 1,453,000 square feet. The buildings utilize an area of approximately 157,000 square feet. There are 34,325 feet, or about 6½ miles of track, which include two sets of erecting tracks, four sets of unloading tracks, one locomotive and crane repair track and three tracks for painting.

An erecting set comprises six tracks spaced at 17 feet, 58 feet, 30 feet, 58 feet and 17 foot centers. The two outside tracks at each side are crane and unloading tracks. The two middle tracks are the erecting track and crane track. The erecting track is covered for its entire length of approximately 1,300 feet and is divided into sections, according to the phases of construction, as follows: 200 feet, truck storage and erection; 450 feet, erection and riveting; 180 feet, flooring; 300 feet for side and end lining, and 220 feet for roofing. The painting facilities consist of three tracks, each 1,000 feet long, which were never covered as originally planned.

The 58-foot intervals between tracks, at the first approach to the plant proper, are used for storage of car boxes, but further along the various buildings are placed in this space. The buildings included are the power house, offices, shop buildings, waste sheds, store houses, machine and blacksmith shops and quarters.

Car parts are received from the United States crated in 100-car lots. The crates are sorted and stored until the parts for a 100-car lot are on hand. Erection starts with the assembling of trucks, which are then moved along the track to the erection position, where a frame, to which the outside fittings have been previously riveted, is placed on the trucks by two 15-ton locomotive cranes. The car then passes through the various phases of construction, each operation comprising a phase, being completed as nearly as possible at the same time, so that no delay occurs.

The first car was turned out at La Rochelle shop February 26, 1918. Since that time, up to and including December 11, 1918, 14,830 cars have been completed. The maximum daily output was obtained on September 26, 1918, when 150 cars were completed. The maximum weekly total was obtained during the week September 22 to 29, 1918, and was 700 cars. The maximum monthly total, obtained in September, 1918, was 2,370 cars. These totals include cars of all types, that is, flat, box, low and high side gondolas, refrigerator and Roger ballast cars.

Shop Labor Situation in 1918

Year Marked by Wage Advances and Decreases in Unit Production; Supply of Labor Now Improving

During the year 1918 changes took place in the labor situation that were little short of revolutionary. To understand the situation during the past year, it is necessary to look back as far as 1915 and 1916. In those years the industries in the Eastern states turned a great deal of their production over to war work, thus creating an unusual demand for men skilled in the mechanical trades. The wages paid in the war industries were higher than the prevailing scale and after a time affected the labor conditions on the railroads. Some of the most highly skilled mechanics were drawn away from railroad work by the prospect of higher remuneration and those remaining in the shops became dissatisfied with the relatively low rates of pay they received. The shortage of mechanics grew steadily worse during 1916 although in that year practically all the railroads increased the wages of the shopmen, the advances granted to the various craft in general varying from one to four cents an hour.

After the declaration of war there was a scramble among the mechanics to get into arsenals and navy yards and later in the year many of the men who had been employed on steel car work found lucrative positions in the ship yards. In June, 1917, the Railroad's War Board, realizing the necessity of maintaining the mechanical department forces, asked the Council of National Defense to define the policy with regard to the enlistment of machinists or other skilled railroad employees. It was felt at that time that there was danger of mechanics being drawn from the shops in such numbers as seriously to impair the efficiency of the railroads. The warning of the War Board was not heeded, consequently many of the best mechanics left railroad service and their places were filled by men who had had but limited experience. As these men in turn developed into skilled mechanics they likewise left the railroads to take better paying positions in war industries. This resulted in a very large labor turnover.

Roads Attempt to Maintain Shop Forces.

The railroads tried as best they could to keep the mechanics in their employ, and during 1917 granted numerous wage advances, ranging from two to eight and one-half cents an hour. One of the principal increases was that put into effect in the Southeast. According to a decision rendered by Secretary of Labor W. B. Wilson, on August 24, 1917, the shopmen in this territory received wage advances of six and one-half to eight and one-half cents an hour. The rates of pay for machinists, boilermakers and blacksmiths with the advances, ranged from 45 to 52 cents an hour. It is interesting to note that the wage increases granted in 1917 were in general higher on Western roads than on Eastern roads, in spite of the fact that the greatest shortage of mechanics was in the East. This was no doubt due to the fact that the Eastern roads had experienced serious losses in net revenues and being denied an increase in freight rates were not financially able to pay higher wages.

The shortage of mechanics caused discipline in the shops to slacken. The men became indifferent about their work, and production decreased very considerably. The percentage of men absenting themselves from work became very high and to counteract this tendency some roads inaugurated the practice of giving bonuses to men who were absent not more than two or three days during the month. The attempts to keep mechanics in the shops by increasing the wages did not have the desired results, consequently railroads in all sections of the country began to train women to do light work, both skilled and unskilled.

One of the factors that lowered the efficiency of the shops was the inadequate compensation the foremen received. Their earnings were often less than the average wages of the men under them, and with such conditions prevailing, it was difficult to secure competent men for supervisory positions. In fact, many foremen gave up their places and returned to work at their trade.

As the shortage of labor became more pronounced, the demands for wage increases grew more frequent. In December, 1917, the federated shop crafts on the Middle Western roads proposed rates of 62½ cents an hour for the locomotive shop crafts, 50 to 56 cents for carmen, and 44 cents for helpers, no increase to be less than 10 cents an hour. This tentative schedule was submitted to the members of the unions for their approval, but before the demands were presented to the roads, President Wilson assumed control of the transportation systems.

LABOR CONDITIONS AT THE BEGINNING OF FEDERAL CONTROL.

Such in general was the labor situation when the roads were taken over by the Government. The developments up to that time indicated clearly the conditions that would have to be met as long as the war lasted. The traffic was certain to be abnormally heavy, requiring motive power and rolling stock in good working order to handle it efficiently. The supply of labor instead of increasing, would decrease as more and more men entered military service. The problem therefore, was to secure increased output in spite of the constant depletion of the existing forces.

The absolute control over labor which the Government could exercise, made the problem less difficult for the Railroad Administration than it had been for the individual roads, and hope was expressed that the labor problem would be handled in a broad and thorough manner. However, the Railroad Administration has treated the labor question primarily as a *wage* problem and not as a *production* problem. The increased output required in the shops might have been secured through an increase in the production per man, either by working longer hours or by speeding up during the working period; or through an increase in the labor supply, by raising the wages sufficiently to attract labor from other fields, or by training women to fill those positions for which they are qualified. During the past year, the Director General and his staff have increased the hours of work and raised the wages, but they have made practically no effort to introduce women in railroad work and instead of placing a premium on high unit production, they have actually discouraged such measures by refusing to allow increases in piece work rates.

The wage problem was given consideration by Director General McAdoo soon after his appointment. A wage commission headed by Secretary of the Interior Franklin K. Lane, was appointed on January 18, to make recommendations for wage adjustments and on February 9 the Division of Labor was created with W. S. Carter as director. The first action that Mr. McAdoo took with regard to the labor situation in the mechanical department came in February. At that time he announced that the railroad shop employees, acting through A. O. Wharton, president of the railway department of the American Federation of Labor, had agreed that the hours of labor in the shops should be increased to 70 per week and that apprentices with three years' experience and helpers with five years' experience should be promoted to the rank of mechanic. It was also stipulated that mechanics were not to be denied employment for any cause other than inability to perform the work.

WAGE ADVANCES FOR MECHANICAL DEPARTMENT EMPLOYEES.

Director General McAdoo's promise to grant adequate wages was quite as effective in holding the men as any actual increase could have been, and comparatively few mechanics left railroad service during the early part of the past year. On May 25, the findings of the Railroad Wage Commission were made public. The commission recommended increases on a sliding scale ranging from $20 a month for those who, in December, 1915, received $46 or less, to $1 for those receiving $249. The Director General modified these recommendations and established a minimum rate of 55 cents an hour for machinists, boilermakers and blacksmiths. The employees of the mechanical department were not satisfied with the increases awarded by the provisions of General Order No. 27, principally because it took no account of the wage advances secured during 1916 and 1917. The disapproval of the findings of the commission was so strong that strikes took place in two shops. It was evident that the employees had expected to be awarded wages commensurate with those paid to mechanics in war industries. In hearings before the Board of Wages and Working Conditions, the representatives of the shopmen's organization asked for a rate of 75 cents an hour for car and locomotive shop men with over four years' experience and 56¼ cents for car men with less than four years' experience. Supplement No. 4 to General Order No. 27, issued on July 24, established a minimum rate of 68 cents an hour for mechanics, boilermakers, blacksmiths, sheet metal workers, molders and first class electrical workers, 58 cents an hour for car men and second-class electrical workers, and 45 cents an hour for helpers. It provided also for foremen paid on an hourly basis a rate 5 cents higher than their respective craft, and an increase of $40 a month for foremen paid on a monthly basis, with a minimum of $155 and a maximum of $250. For the sake of uniformity, all foremen were later placed on an hourly basis. The basic eight-hour day was established, and the increases were retroactive to January 1.

Other classes of labor in the shops were granted increased wages under the provisions of supplement No. 7, issued September 5, 1918, the minimum rates established being as follows: For stationary engineers, $110 per month; for stationary firemen and power house oilers, $90 a month; for locomotive boiler washers, 38 cents an hour; for power transfer and turntable operators, 33 cents an hour; for shop, roundhouse and storehouse laborers, 31 cents an hour, and for common labor 28 cents an hour. The rates specified in supplement No. 7 were not retroactive but were made effective September 1, 1918.

The increases in the wages resulting from the application of the new schedules, have been variously estimated at from 40 to 60 per cent. in the locomotive department, and from 40 to 90 per cent. in the car department. The increase would vary considerably in different shops, depending on the basis of payment previously in force. The supplements to General Order No. 27 made no provision for increases in the piece work prices, and this has resulted in the abolition of piece work in a large number of the shops.

EFFECTS OF HIGHER WAGES ON LABOR CONDITIONS.

In general the mechanical department employees were well pleased with the wages awarded by supplements Nos. 4 and 7. The migration of railroad shop employees to other industries practically ceased and many who had left railroad service returned to their former occupations. Director General McAdoo stated that he expected every railroad employee by faithful and efficient service to justify the large increases of pay granted to them. However, the evidence at hand indicates that this result was not secured. The shopmen were given an opportunity to increase their earnings very materially, but instead of working steadily after the new rates went into effect, many worked only enough days in each month to earn a small amount in excess of what they formerly received. The percentage of absentees in the shops was in some instances as high as 30 per cent. and to find 20 to 25 per cent. "laying off" was by no means unusual. While piece work systems were not abolished, the earnings under existing piece work rates were in most cases only slightly higher, and in some cases even lower than the established minimum wage for mechanics. Consequently when the higher rates went into effect, there was no longer sufficient incentive for men to increase their production to a point where they would earn more than the guaranteed rate per hour. On the few roads where the rates earned on piece work were considerably higher than the present wages, the system is still in effect and the unit production has not fallen off appreciably. Where the incentive has been removed, however, the output has fallen very markedly. Records of the average earnings on roads which had piece work systems before and since the wage increases went into effect are available. On one typical road the data showed that whereas the men in the car department, under the old piece work system, earned an average of 45 cents an hour, they were now earning 35 cents an hour, but were of course receiving the minimum rate of 58 cents an hour. On another road it was found that the output was but 60 per cent. as much per man as formerly, and 40 per cent. as much work was being turned out per dollar as before. These are by no means extreme instances, as in some cases the records for whole shops show that the men's earnings have dropped to from 20 to 30 per cent. of what they had been while the work was being done at the piece rate. It is probably no exaggeration to say that in the shops where piece work has been eliminated the output per man has decreased 30 per cent. and the labor cost of doing the work has increased 50 per cent.

OVERTIME AND PRODUCTION.

The experience gained during the past year demonstrates plainly that increasing the hours does not increase the output in proportion. In general as much work was done in a ten-hour day as in a 13-hour day, and the officers of one road stated that they expected to secure practically the same output with the shops running 48 hours a week that was obtained when the men were working 70 hours a week. It should be stated, however, that the eight-hour day has not been received with favor particularly by the car men, and under this condition the normal production cannot be secured.

In considering the records of the shops, the fact must not be overlooked that supervising officers were working under unfavorable conditions. The foremen, as a class, were underpaid. Many had given up their positions to return to work at the trade, and this tendency became even more marked after the issuance of General Order No. 27. Had the foremen been granted salaries commensurate with their responsibilities, the labor situation would undoubtedly have been improved. The inadequate wages not only made it difficult to secure competent men for the supervising forces, it also resulted in the foremen losing authority, as where the workers received higher wages than the supervising forces they feel the foremen are their inferiors, and obey instructions grudgingly. It was not until the first of November that the supervising forces were granted adequate wage increases. While the final wage scales for the foremen were in general quite satisfactory, they came too late. The most trying times had passed, and the roads had lost the full production that might have been secured had the foremen been able to exercise complete authority in the management of the shops.

The effect of the Government's attitude toward labor has been clearly shown in the mechanical department. One of the first significant changes was a marked increase in the number of men enrolled in labor organizations. Soon after the Railroad Administration announced that no distinction should be made between members or non-members of labor unions, the representatives of the American Federation of Labor sent organizers to the "open" shops. As a result of the activities of the federation, there is hardly a shop in the country in which a local lodge has not been formed. This movement has been furthered by the evident advantages of organized labor in enforcing its claims on the administration and by the widespread opinion among the workers that the organized crafts have been especially favored in the wage awards.

GOVERNMENT ATTITUDE TOWARD LABOR.

The removal of the power of determining wages from the officers of the individual roads had an unfortunate effect on discipline in the shops. The men became imbued with the belief that any favors they were to receive would be determined by the authorities at Washington and that the administration of discipline would likewise be governed by the central body. This resulted in flagrant cases of insubordination. Men refused to obey the orders of the foremen in the shops, denied the power of the supervising officers to discharge them, and whenever they were not satisfied with decisions in matters affecting wages or working conditions, carried the matter to Washington in the form of complaints or grievances. In general the men were inclined to give credit for all the benefits they received to the Railroad Administration, but placed all the blame for undesirable conditions on the local officers. The general effect of this situation on the morale of the workers can readily be appreciated.

SUPERVISORS TRY TO INCREASE PRODUCTION

Late in the year, the administration officers seem to have arrived at a realization that the men were not giving a fair day's work for a fair day's pay. Belated attempts were made to increase the production of the shops. The general supervisors of equipment visited a number of plants, and by personal appeal, endeavored to speed up the workers and restore discipline. These men have stated that the workers are not giving the Government the output which they had given to the railroads under private control, regardless of the fact that wages have been increased and working conditions improved. In one case following an unpopular reduction in the working hours, the men deliberately cut the output more than 50 per cent. The equipment inspectors have insisted that insubordination must cease, and that shopmen must obey their officers. This movement should result in better output in a short time under the present conditions.

Since the signing of the armistice the labor situation has undergone a rapid change. In the sections of the country where many war industries were located, there are now plenty of mechanics available. In other sections a slight shortage of skilled labor is reported. The working period in the shops has been reduced to eight hours per day, and where it is found that a single shift will not give the required output, the second shift is to be organized. This arrangement has been put in force in order to give employment to the maximum possible number of men during the reconstruction period. With the decrease in the demand for skilled labor there has come a change in the attitude of the workers. The unit production probably reached the low point during the last months of the year. During the coming months there should be a marked improvement in the morale and in the output of the shops.

German Railway Equipment for France.—Press despatches state that on December 29 Germany would deliver to France 2,600 locomotives and 70,000 cars.

Two More Standard Locomotives

Heavy 4-8-2 and Light 2-10-2 Types Are Well Proportioned and Have Essentially the Same Boiler

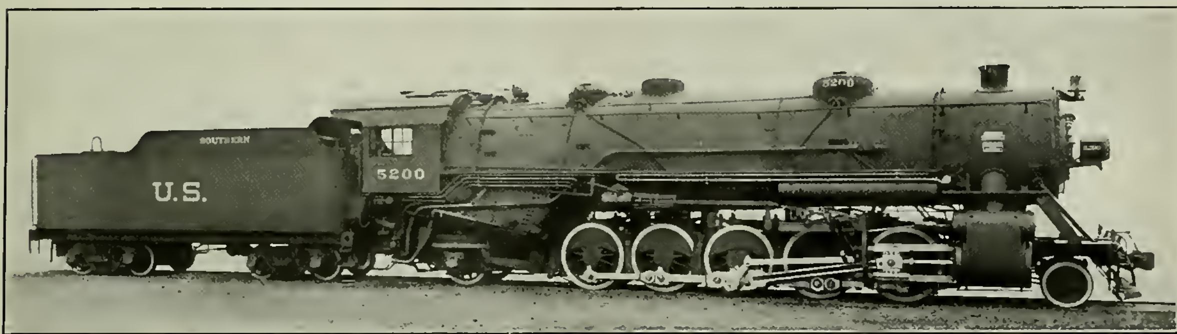
The first locomotives of the United States Railroad Administration standard heavy Mountain type and light Santa Fe type have recently been delivered by the American Locomotive Company.

The boilers used on these two types are practically identical; the size of the shell, the number and diameter of tubes and flues and the principal firebox dimensions are the same. The principal difference between the two boilers is in the slope of the mudring, the height of the center line of the boiler on the Mountain type locomotive making possible the maintainance of a deeper backhead with less inclination of the grate than was necessary on the 2-10-2 type. The design of both types conforms closely in the details used to the other standard types which have already been built, and a considerable measure of interchangeability exists in the details of the various classes.

The boiler provides ample capacity in each case. Stating the relation between the boiler capacity and the cylinder demand on the basis of Cole's ratios, the Mountain type locomotive has practically a 100 per cent boiler, while the boiler for the Santa Fe type is equivalent to about 109 per cent. The design of the boiler itself is well balanced, both as to the ratio of tube length to diameter and the ratio of grate area to heating surface. The latter relation checks almost exactly with Cole's assumption of 120 lb. of coal per square foot of grate per hour at the maximum boiler output.

In the table is presented a comparison of the principal dimensions of the standard 4-8-2 type locomotive with a few of the recently built locomotives of this type. It will be found that although the total weight of this locomotive is slightly less than that of the A. T. & S. F. locomotive,* the weight on the drivers is considerably higher, as is also the tractive effort, which exceeds that of any locomotive of this type previously built. It will also be observed that the cylinder stroke is longer than has usually been adopted for locomotives of this type, which accounts for the high starting tractive effort obtainable.

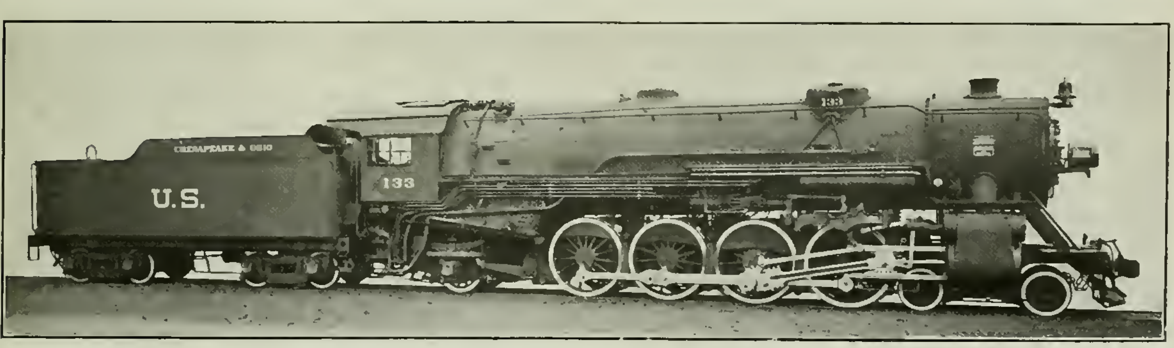
A similar comparison of Santa Fe types shows less of interest, as the comparison in order to be fair must be confined to locomotives of medium weight; the light 2-10-2 type is designed to keep within axle loads of 55,000 lb.



The Standard Light 2-10-2 Type Locomotive

Comparison of Principal Dimensions of Notable 4-8-2 Type Locomotives

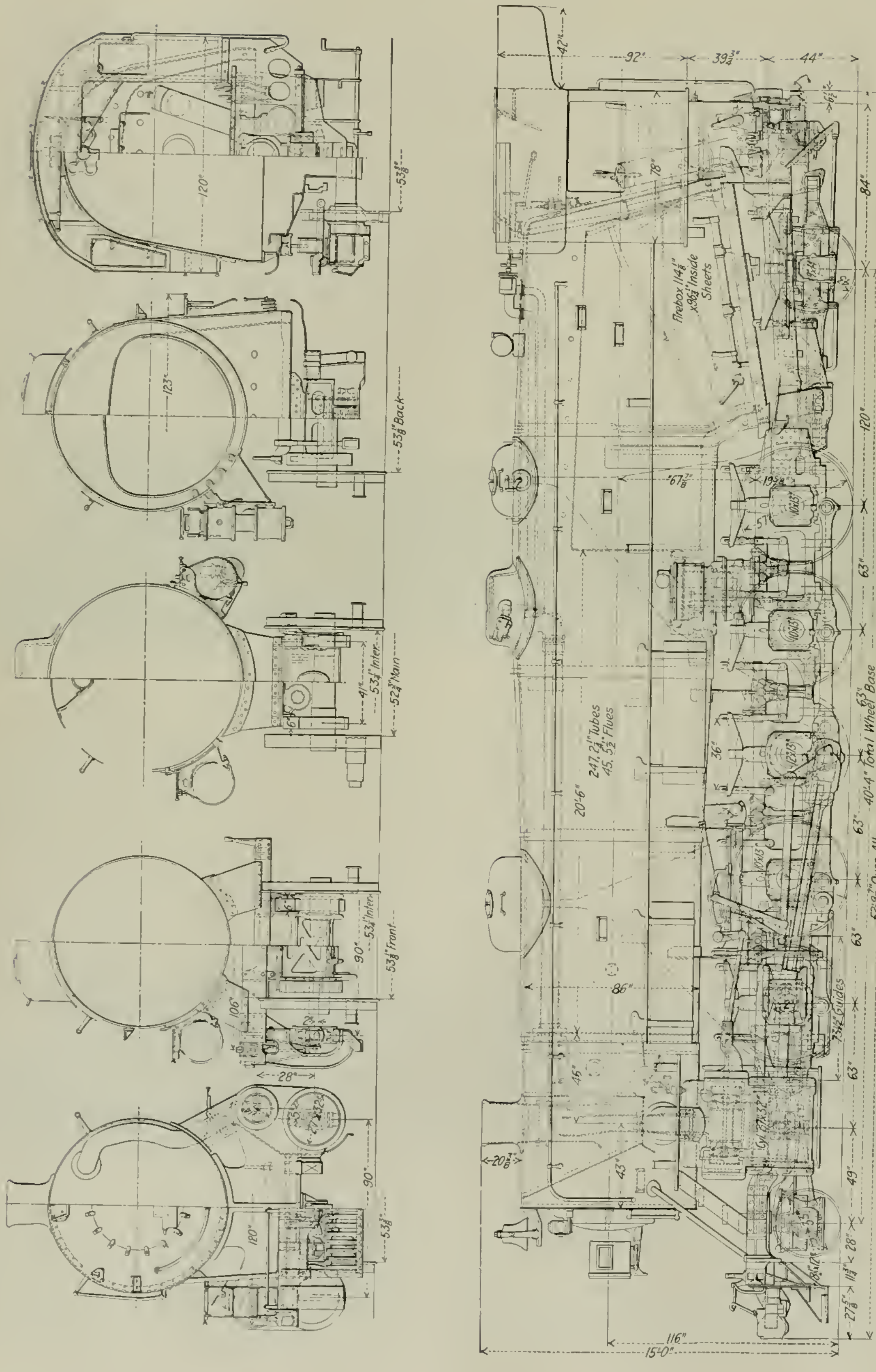
Road	U. S. Std.	Santa Fe	N. Y. C.	N. & W.
Builder	American	Baldwin	American	N. & W.
Year built	1918	1918	1916	1916
Tractive effort, lb.	58,000	54,000	50,000	57,000
Total weight, lb.	352,000	353,900	343,000	341,000
Weight on drivers, lb.	243,000	227,700	234,000	236,000
Cylinders, in.	28 by 30	28 by 28	28 by 28	29 by 28
Boiler pressure, lb. per sq. in.	200	200	185	200
Diameter of drivers, in.	69	69	69	70
Evaporating heating surface, sq. ft.	4,666	4,790	4,430	3,984
Superheating surface, sq. ft.	1,085	1,086	1,212	882
Grate area, sq. ft.	76.3	71.5	66.8	80.3



The U. S. Standard Heavy Mountain Type Locomotive

The tonnage rating charts for the two types were prepared by H. S. Vincent and are similar to those shown in the

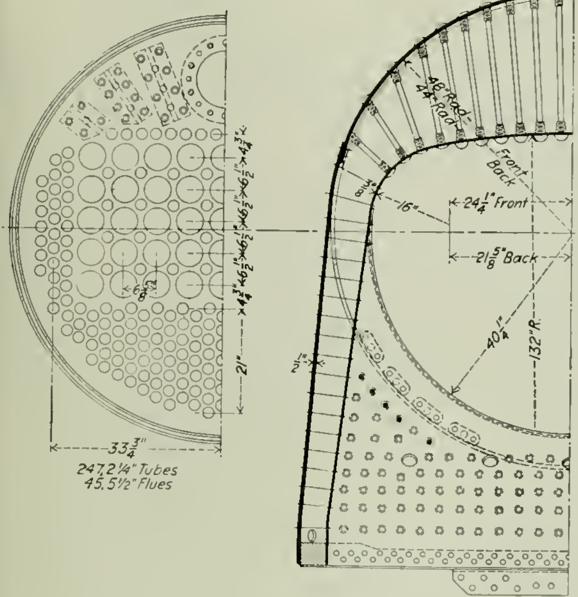
*See the *Railway Mechanical Engineer* for December, 1918, page 649.



Elevation and Cross Sections of the U. S. Standard Light Santa Fe Type Locomotive

Railway Mechanical Engineer for November, 1918, page 607.†

The boiler for both types is 86 in. in diameter outside of the first ring and is increased to an outside diameter of 96 in. at the firebox by a conical course just ahead of the dome.

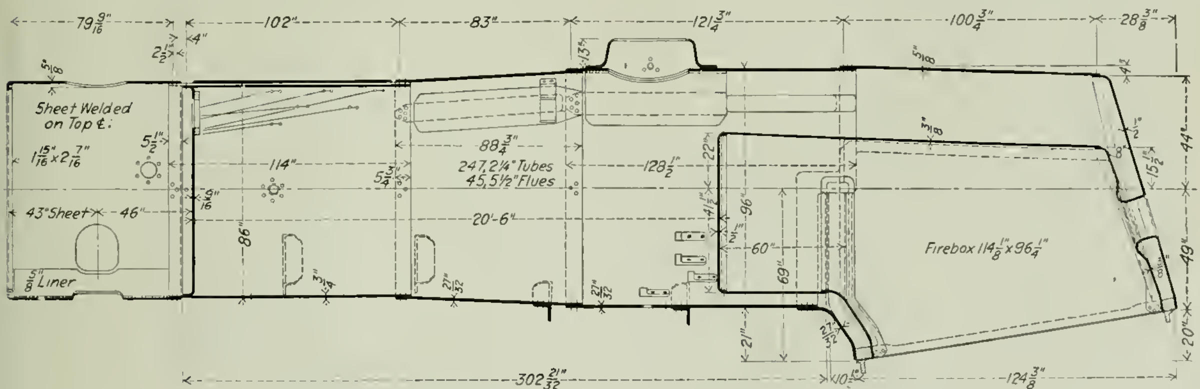


Firebox Section and Tube Sheet Layout

The longitudinal seam in the dome course is placed at the left side of the top center line, the dome pad being used as an inside welt strip for the portion of the seam in front of the combustion chamber. The dome is of pressed steel, standing eight inches above the top of the boiler shell on the 4-8-2 and 13 in. on the 2-10-2 type, and has a clear opening of 25 in. The seam on the conical course is placed to the right of the top center line, while the forward, straight course is closed on the top center line. The tubes and flues are 20 ft. 6 in. long, ending at the rear in a combustion chamber tube sheet which is placed five feet ahead of the firebox throat. Type A superheaters and Security Brick arches are used on both types of locomotives.

Both locomotives are fired with stokers, the 4-8-2 type being equipped with a Standard stoker and the 2-10-2 type with the Duplex. Both have Franklin power grate shakers and the 4-8-2 type is equipped with a Shoemaker firedoor, while the 2-10-2 type has the Franklin door. In both cases the throttle rigging is of the Chambers backhead type. On the Mountain type locomotives the boiler is fed by Hancock No. 13 non-lifting injectors, while on the 2-10-2 type the Ohio non-lifting injectors of the same number are used. The 4-8-2 type boiler is fitted with Consolidated safety valves, while the Santa Fe type has Coale valves.

The frames of both locomotives are similar in design, both having single front rails cast integral with the main frames and Commonwealth rear frame cradle castings spliced to the rear ends of the main frames. The frames of both types are six inches wide. The top rail on the Mountain type has a maximum depth over the pedestal of 7⅝ in., with a minimum depth of 6½ in. The lower frame rail is 5⅛ in. in depth over the ends of the pedestal binders and 4⅝ in. in depth at the minimum section. The standard pedestal taper in all cases is one in twelve. On the 2-10-2 type the top frame rail is 7⅛ in. deep over the pedestal with a minimum section 6 in. deep, while the lower rail has maximum and minimum depths of 4¾ in. and 4¼ in., respectively. The frame bracing is similar in both cases. Vertical crossties are bolted to the pedestal jaws of each pair of drivers except the rear, the forward casting also being attached to the inclined lower rail immediately back of the cylinders. Horizontal crossties are attached to the top rails of the Mountain type locomotive in front of the forward drivers and between the first and second, second and third, and third and fourth pairs of drivers. The front crosstie also supports the guide yoke. The bracing of the Santa Fe type is similar; starting with the guide yoke, which is located between the first and second pairs of drivers, transverse castings are attached to the top rails between each succeeding pair of wheels.



Longitudinal Section of the Boiler for the Standard Light Santa Fe Type

The cylinders of the Santa Fe type locomotive are the same diameter and stroke as those of the heavy Mikado type and, including the cylinder and valve chamber heads, are interchangeable with those used on the latter locomotive. The Mountain type cylinders do not interchange with any other type yet built, but the valves and steam chest covers used on these locomotives are interchangeable with those used on the

†The curves of hauling capacity are constructed for a car resistance of 4 lb. per ton. The chart may be used for any other car resistance or for any combination of resistances by converting them into terms of grade.

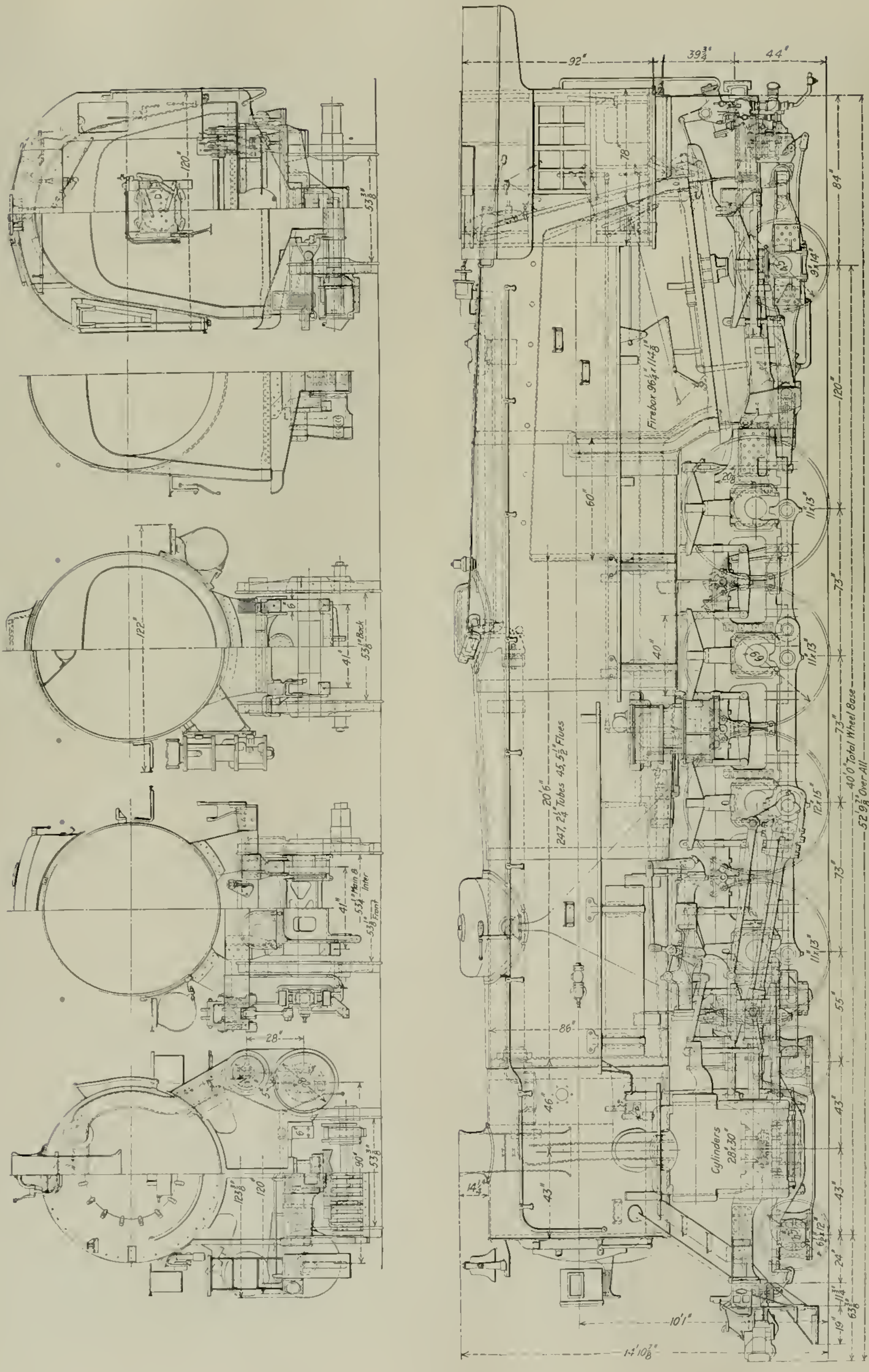
1 lb. car resistance = .05 per cent grade
1 degree curve uncompensated = .04 per cent grade

For example: Find the tonnage which can be hauled in passenger service by the 4-8-2 type locomotive, on 0.5 per cent grade combined with 4 deg. uncompensated curve at 40 m.p.h.

From Table III (see the November issue, page 610) the resistance of passenger coaches at 40 m.p.h. is 6.65 lb. per ton. The equivalent grade is then:

$$0.5 + (4 \times .04) + (6.65 \times .05) = 0.7925 \text{ per cent}$$

At the intersection of the ordinate for 0.7925 per cent grade with the drawbar pull curve for 40 m.p.h., we find 925 tons as the capacity of the locomotive.



Elevation and Sections of the Standard Heavy Mountain Type Locomotive

2-10-2 type, both the light and heavy Mikado types and the eight-wheel switcher. The crosshead body, with the exception of the finish for the wrist pin fits, the front end main rod clearance and the piston rod fit is identical for the heavy Mountain type locomotive, both the light and heavy Mikado type locomotives and the eight-wheel switcher. The crosshead shoes are not interchangeable. The piston and rod used on the light Santa Fe locomotive are identical with those used on the heavy Mikado type. Hunt-Spiller gun iron is used for piston and crosshead wearing shoes, piston and valve packing rings and cylinder and valve chamber bushings on both the Mountain and Santa Fe types. Paxton-Mitchell metallic packing is used for the piston and valve rods on both types.

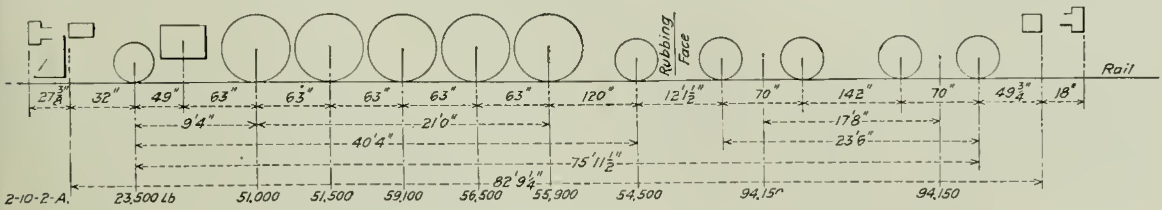
On both the light Santa Fe and the heavy Mountain types the main driving journals are 12 in. in diameter by 13 in. long. The other journals on the Mountain type are 11 in. in diameter by 13 in. long and the driving boxes for these axles interchange with the main driving box for the light Mikado type locomotive, with the exception of slight differences in the finish of the crown brass, which is bored out 1/32 in. oversize for the Mountain type journals and 1/100 in. oversize for the main journals of the Mikado. The other journals on the Santa Fe type are 10 in. in diameter by 13 in. in length and the driving boxes used on these axles interchange with those of this size used on both the light and heavy Mikado type locomotives.

The leading trucks on both locomotives are of the constant resistance type, while the trailing trucks are of the Cole-Scoville type, the journals in both cases being 9 in. in diameter by 14 in. in length.

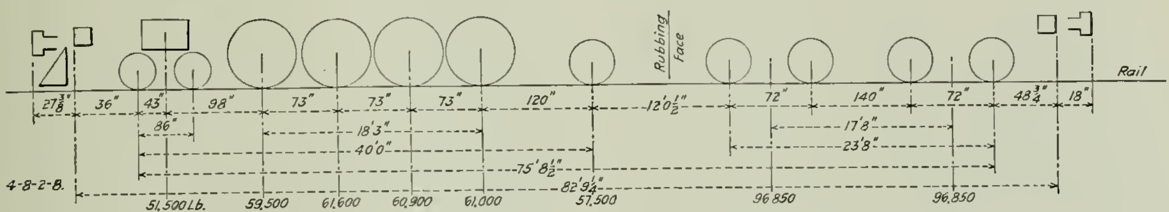
The Baker valve gear is applied on the Mountain type locomotives while the Santa Fe type are fitted with the Southern valve gear. In both cases the valve motion is controlled by the Ragonnet power reverse gear.

Both locomotives are served by tenders carrying the standard 10,000-gal. tank mounted on Commonwealth cast steel frames. The passenger tenders are fitted with equalized trucks having frames of the built-up type, while the trucks under the freight tender have cast steel side frames. In both cases the trucks are fitted with Woods roller side bearings. The connection between the engine and tender includes the Unit safety drawbar and Radial buffers, while the rear ends of the tenders are fitted with Westinghouse D-3 type draft gear.

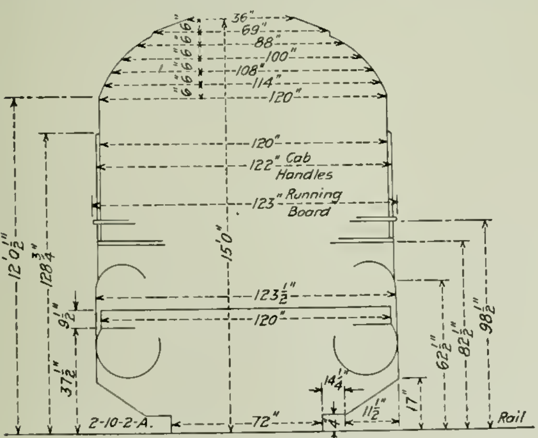
Among the specialties are Everlasting blow-off cocks on the 4-8-2 type, Murden blow-off cocks on the 2-10-2 type, Ashcroft and Ashton steam gages on the 4-8-2 and 2-10-2 types, respectively, Detroit six-feed six-pint lubricators on both types and Leslie steam heat equipment on the 4-8-2



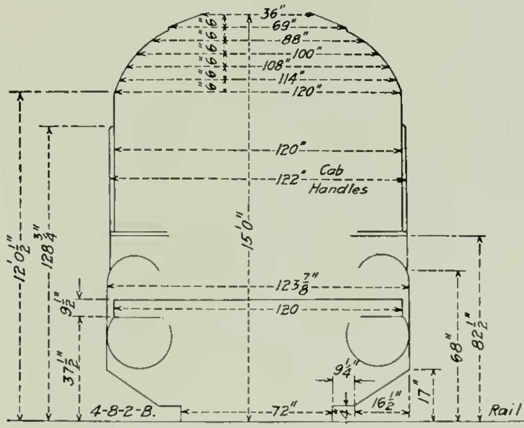
Wheel Loading and Spacing Diagram for the Standard Light Santa Fe Type Locomotive



Wheel Loading and Spacing Diagram for the U. S. Standard Heavy Mountain Type Locomotive



Clearance Diagram for the Light 2-10-2 Type



Clearance Diagram for the Heavy 4-8-2 Type

type. Greenlaw flexible pipe couplings are used on the 4-8-2, while the 2-10-2 is fitted with Barco couplings.

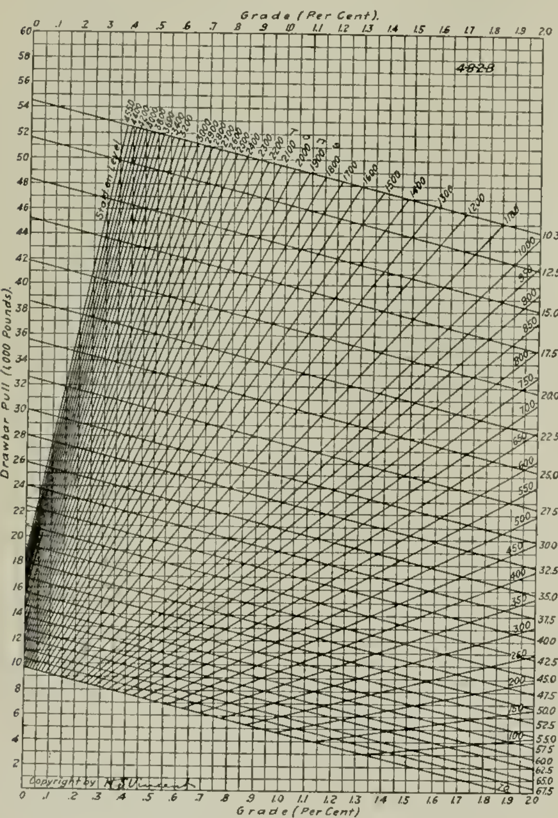
The principal dimensions and data for both types are given in the clearance and wheel load diagrams, which were prepared by F. P. Pfahler, chief mechanical engineer, Division of Operation, United States Railroad Administration, and in the following table:

General Data

	4-8-2	2-10-2
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Service	Passenger	Freight
Fuel	Soft coal	Soft coal
Tractive effort	58,000 lb.	69,400 lb.
Weight in working order	352,000 lb.	352,000 lb.
Weight on drivers	243,000 lb.	274,000 lb.
Weight on leading truck	51,500 lb.	23,000 lb.
Weight on trailing truck	57,500 lb.	54,000 lb.
Weight of engine and tender in working order	547,500 lb.	540,300 lb.
Wheel base, driving	18 ft. 3 in.	21 ft.
Wheel base, total	40 ft. 0 in.	40 ft. 4 in.
Wheel base, engine and tender	75 ft. 8½ in.	76 ft. ½ in.

Ratios

Weight on drivers ÷ tractive effort	4.2	3.9
Total weight ÷ tractive effort	6.1	5.1
Tractive effort × diam. drivers ÷ equivalent heating surface*	637.0	629.6
Equiv'l't heat. surface* ÷ grate area	82.4	82.4
Firebox heating surface ÷ equivalent heating surface,* per cent	5.9	5.9
Weight on drivers ÷ equivalent heating surface*	38.7	43.6
Total weight ÷ equivalent heating surface*	56.0	56.0
Volume both cylinders	21.4 cu. ft.	21.2 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	293.9	296.3
Grate area ÷ vol. cylinders	3.6	3.6



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Tonnage Rating Chart for the U. S. R. A. Standard Heavy Mountain Type Locomotive

Cylinders

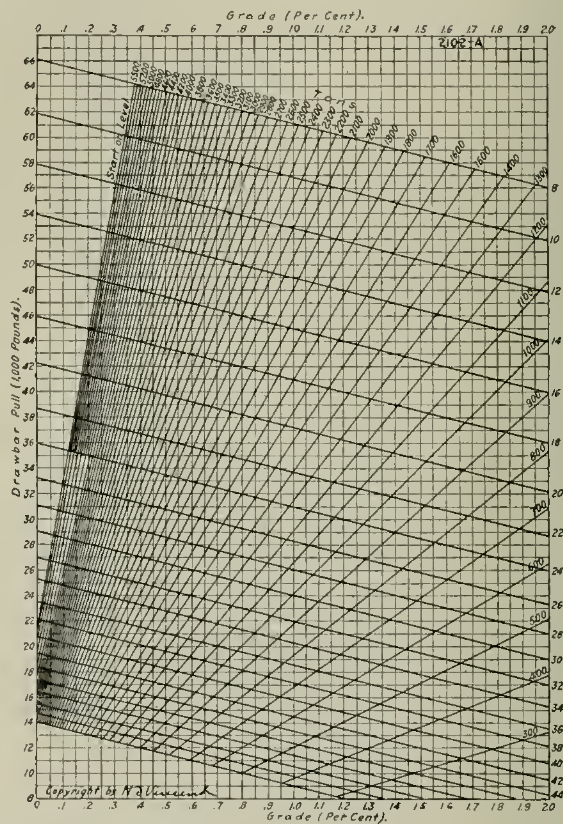
Kind	Simple	Simple
Diameter and stroke	28 in. by 30 in.	27 in. by 32 in.

Valves

Kind	Piston	Piston
Diameter	14 in.	14 in.

Wheels

Driving, diameter over tires	69 in.	57 in.
Driving journals, main, diameter and length	12 in. by 13 in.	12 in. by 13 in.
Driving journals, others, diameter and length	11 in. by 13 in.	10 in. by 13 in.
Engine truck wheels, diameter	33 in.	33 in.
Engine truck, journals	6½ in. by 12 in.	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.	43 in.
Trailing truck, journals	9 in. by 14 in.	9 in. by 14 in.



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Tonnage Rating Chart for the U. S. R. A. Standard Light Santa Fe Type Locomotive

Boiler

Style	Conical	Conical
Working pressure	200 lb. per sq. in.	200 lb. per sq. in.
Outside diameter of first ring	86 in.	86 in.
Firebox, length and width	114⅛ in. by 96¼ in.	114⅛ in. by 96¼ in.
Firebox plates, thickness—Sides, back and crown, ⅜ in.; tube	½ in.	⅜ in.; ½ in.
Firebox, water space—Front, 6 in.; sides and back	5 in.	6 in.; 5 in.
Tubes, number and outside diameter	247—2¼ in.	247—2¼ in.
Flues, number and outside diameter	45—5½ in.	45—5½ in.
Tubes and flues, length	20 ft. 6 in.	20 ft. 6 in.
Heating surface, tubes	2,970 sq. ft.	2,970 sq. ft.
Heating surface, flues	1,323 sq. ft.	1,323 sq. ft.
Heating surface, firebox	373 sq. ft.	373 sq. ft.
Heating surface, total	4,666 sq. ft.	4,666 sq. ft.
Superheater heating surface	1,085 sq. ft.	1,085 sq. ft.
Equivalent heating surface*	6,283 sq. ft.	6,283 sq. ft.
Grate area	76.3 sq. ft.	76.3 sq. ft.

Tender

Tank	Water bottom	Water bottom
Frame	Cast steel	Cast steel
Weight	193,700 lb.	188,300 lb.
Wheels, diameter	33 in.	33 in.
Journals, diameter and length	6 in. by 11 in.	6 in. by 11 in.
Water capacity	10,000 gal.	10,000 gal.
Coal capacity	16 tons	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

Railroad Administration News

New Director General Not Named; Other Resignations; Circulars Issued from Washington and the Regions

As this issue goes to press no successor to Mr. McAdoo has been named although Walker D. Hines appears to be the preferred candidate. Mr. Hines has been with the Railroad Administration since it was formed a year ago, having been formerly chairman of the Board of Directors of the Atchison, Topeka & Santa Fe. He is the most logical successor to Mr. McAdoo, having followed through the year's developments with him.

During the month Judge Robert S. Lovett, the head of the Division of Capital Expenditures, resigned to return, after two months' rest, to the Union Pacific as its president. On December 20, Carl R. Gray, director of the Division of Operation, tendered his resignation, to take effect January 15. Mr. McAdoo delayed this abdication of the director generalship until after he presented his plea for the five-year extension plan to Congress. He then expects to go to California with his family for a rest.

EMPLOYEES WANT MCADOO TO STAY

Mr. McAdoo has received hundreds of letters and telegrams expressing regret because of his resignation as director general of railroads and appreciation of the work he has accomplished, from all classes of railroad service, from employees to managers and corporation officers. The employees, however, are most expressive of their desire to retain him as boss and many of them have backed up their words by concrete evidence. In addition to the numerous offers to "chip in" toward an adequate salary, four employees of the St. Louis-San Francisco enclosed certified checks for $1 each as a Christmas present.

The executive council of the railway department of the American Federation of Labor called on Mr. McAdoo on Saturday after his return from his southern trip, to present resolutions asking him to retain his office, and also another resolution, which was transmitted to the President, proposing legislation which would "provide a salary in keeping with the services rendered." The resolutions also protested against any plan to return the roads back to private control.

RAILROAD ADMINISTRATION NOT CANCELLING ORDERS

In reply to various inquiries that have reached Washington regarding rumors that the Railroad Administration had cancelled or was likely to cancel outstanding orders for equipment, officials of the Administration say that no cancellations have been made, except in the case of the recent orders for 600 locomotives, which were held up and then reinstated before the contracts were formally signed, and it is understood that none are proposed, although as reported last week an investigation was undertaken of the situation as to the outstanding car orders.

DIRECTOR GENERAL'S CHRISTMAS MESSAGE TO RAILROAD MEN

"Christmas this year will have a special significance to peoples everywhere. For the first time in four years the world is at peace and railroad men can be happy in the consciousness that they have contributed their full share to this result. I shall always remember the splendid way in which they applied themselves to the task of running the railroads at a time when their efficient operation was absolutely fundamental to the winning of the war. I am proud to have been associated with them in this great job.

"The railroads have not alone carried the tremendous burden thrown upon them by the war, but they are now in better shape than ever before in our history. For the coming winter I have no fear of their ability to do the work required of them.

"And now, as I am about to sever my connections with the officers and employees of the railroads, I want to assure them of my deep regret at being forced to take this step. Among the happiest memories of my life will be those connected with my work as director general of railroads. I shall always cherish the friendships I have formed with railroad officers and employees, and I take this opportunity to assure them that although I shall no longer be their 'boss,' I shall always be their friend."

RULES FOR INSPECTING AND TESTING STATIONARY BOILERS

The Division of Operation has issued Mechanical Department Circular 11 dealing with the rules and instructions for the inspecting and testing of stationary boilers, as follows:

Rule 1—These rules shall apply to all steam boilers and their appurtenances operated by railroads under Federal control, except the boilers of locomotives or boilers used solely for heating which carry pressure not exceeding 15 pounds per square inch.

Rule 2—The chief mechanical officer of each railroad will be held responsible for the general design, construction, and inspection of all boilers covered by these rules. He must know that all inspections are made in accordance with the rules, and that the defects disclosed by any inspections are properly repaired before the boiler is returned to service.

Rule 3—The working pressure of each boiler shall be determined by the mechanical engineer, using the formula commonly used in determining safe working pressures, and after a thorough inspection and report by a competent inspector. The minimum factor of safety allowed shall be four.

In determining safe working pressure, the maximum allowable stress shall be 7,500 pounds per square inch for staybolts, and 9,000 pounds per square inch for round or rectangular braces supporting flat surfaces.

Rule 4—Each boiler shall be given a serial number by the operating railroad. A metal badge plate showing this number and the safe working pressure shall be attached to each boiler.

Rule 5—Specifications of each boiler shall be kept on file in the office of the chief mechanical officer of the railroad. Within ninety days after this rule becomes effective, each railroad will file report (Form MD-25) with the chief mechanical officer of the railroad and a copy with the Assistant Director, Division of Operation, in charge of the Mechanical Department, United States Railroad Administration, Washington, D. C., for each boiler subject to these rules, giving all the data called for thereon.

Rule 6—Each boiler shall have at least one safety valve of sufficient capacity to prevent an accumulation of pressure more than five per cent above the working pressure and shall be connected direct to boiler.

Safety valves shall be set at pressure not to exceed six pounds above the allowed working pressure.

Working safety valve on boiler shall be tested each day boiler is in use. Failure of safety valve to open before an excess pressure of ten pounds has been reached must be immediately reported to the proper authority, and repairs made.

Not less frequently than once each three months all safety valves on boiler shall be tested and adjustment made, if necessary. At this test, as well as at all other tests where the safety valves are adjusted, two steam gages shall be used, one of which shall be in full view of the person adjusting the valves.

Rule 7—Each boiler shall have a steam gage, graduated to at least fifty pounds above the working pressure, connected direct to steam space of boiler, equipped with a suitable siphon and with not more than one cock or valve between boiler and gage. This cock to be located near steam gage.

Steam gages shall be tested at least once each three months, or whenever any irregularity is shown and shall also be tested before any adjustment is made of the safety valves. Each time gage is tested, siphon pipe and cock must be cleaned and examined.

Rule 8—Each boiler shall have at least three gage cocks and one waterglass, so located that the lowest reading shall be at least three inches above the lowest safe water line. Each waterglass shall be equipped with a valve at each end of glass and with a blowoff or drain at bottom of glass. Gage cocks, waterglass and water column valves, cocks and connections shall be maintained in an operative condition free from leaks and shall be cleaned of scale each time boiler is washed.

Suitable lights shall be provided for waterglass and steam gage.

ANNUAL INSPECTION

Rule 9—Before being placed in service and not less than once each twelve months thereafter, each boiler shall be subjected to a hydrostatic pressure 25 per cent greater than the working pressure and the boiler and appurtenances carefully examined while under pressure.

After hydrostatic pressure has been applied, a thorough inspection shall be made of every accessible part of the boiler. Manholes shall be removed to permit of interior inspection.

Boiler having lap joint longitudinal seams should be examined with special care to detect grooving or cracks at edge of seams.

Water tube boilers should be examined with special care to detect blistering on the tubes, tubes bending and leakage or corrosion where tubes are fastened to headers.

Soot and cinders shall be cleaned from furnace and combustion chamber and a thorough inspection made of the brick lining and setting, the fire wall-baffles and grates.

Threaded and flange joints on steam header, steam pipe and blowoff line shall be carefully examined for signs of corrosion or wasting.

After repairs are completed the boiler must be fired up, safety valves set, and boiler and appurtenances examined. All cocks, valves, seams, pipes, flanges and joints must be tight under this pressure.

All defects disclosed by any of the above inspections must be repaired before the boiler is returned to use.

A certified report of the inspection and repairs (Form MD-27) shall be filed with the chief mechanical officer of the railroad and a copy sent to the Assistant Director, Division of Operation, Mechanical Department, Washington, D. C.

Rule 10—Locomotive type boilers working under a pressure of 125 pounds or more shall have the staybolts tested at least once each month. Locomotive type boilers working under a pressure of less than 125 pounds shall have the staybolts tested at least once each three months. Vertical boilers working under a steam pressure of 100 pounds or less shall have the staybolts tested each time the hydrostatic test is applied. No boiler shall remain in service with five or more broken staybolts.

Rule 11—Boilers shall be thoroughly washed as often as water conditions require, but not less frequently than once each month. Special care shall be given to water tube boilers to prevent an accumulation of scale in the tubes and the tubes must be scraped, if necessary. At washout periods, soot, ashes and cinders shall be cleaned from furnace and combustion chamber, and brick lining, setting and fire wall examined.

SEMI-ANNUAL INSPECTION

Rule 12—Not less frequently than once each six months an inspection of the boiler under steam shall be made by a competent inspector. He shall test the safety valves, gage cocks and waterglass, blowoff valve, examine and test the feed pump or injectors, examine steam pipes for leaks, giving close attention to leaks around threaded joints, see that pipes are well braced, that all valves are operative, examine the setting of the boilers and the general condition of the boiler room, with especial reference to fire risks.

He shall report any defects found to the division officer in charge and to the local officer in charge so that prompt repairs can be made.

A certified report of the inspection and repairs (Form MD-26) shall be filed with the chief mechanical officer of the railroad and a copy sent to the Assistant Director, Division of Operation, Mechanical Department, Washington, D. C.

MISCELLANEOUS RULES

Rule 13—Boilers equipped with fusible plugs shall have plug cleaned of scale not less than once each three months.

Rule 14—Boilers in batteries connected to same steam header shall each have a suitable valve between boiler and header, which must be maintained in an operative condition.

Rule 15—Each steam outlet from boiler (except safety valve connections) shall be equipped with a suitable valve, which must be maintained in an operative condition.

Rule 16—Injectors and pumps must be kept in such condition that they will feed water into the boiler against the maximum pressure allowed on the boiler.

Rule 17—Feed water heaters shall be cleaned and inspected as often as water conditions require, but not less than once each three months.

Rule 18—Boilers with any of the following defects shall be withdrawn from service until after proper repairs are made: Cracks in cylindrical boilers or headers; bags or bulges in shells of external fired boilers or unstayed surfaces of internal fired boilers; bulges in arch or water tubes; more than one gage cock inoperative; safety valve inoperative.

Rule 19—Boilers showing indications of having been low in water or of mud burning shall not be used until after inspection by a competent inspector.

Rule 20—Where necessary to plug flues, the plugs shall be tied together with a rod not less than ¼ inch in diameter and a report of same made to the officer in charge, who will have proper repairs made.

Rule 21—When making internal inspection of one of a battery of boilers, another employee will be stationed outside of boiler, whose duty shall be to prevent steam valves from other boilers being opened into boiler being inspected.

Rule 22—The boiler room shall be kept in a clean and sanitary condition, old clothes, waste, etc., must not be allowed to accumulate in or around boiler room.

Rule 23—An annual certificate of inspection shall be posted under glass in a conspicuous place in the boiler room. This certificate shall show the number of the boiler, the allowed working pressure, the date of inspection and the signature of the inspector.

Rule 24—Inspection certificates may be made in triplicate and copy filed with state inspector of boilers, when desired.

The above rules shall become effective January 1, 1919, as minimum requirements and shall be put in full force on each railroad under federal control on that date. When a railroad has in effect additional rules which provide greater safeguards such additional rules may be continued in effect.

SHOPS ON EIGHT-HOUR BASIS

Frank McManamy, assistant director of the Division of Operation, has sent to the regional directors the following interpretation of the director general's order to reduce shop hours wherever practical to eight per day, stating that the numerous inquiries received and the different ways in which this has been put in effect clearly indicates it has not been uniformly understood:

"The purpose of this order was to reduce the hours worked in locomotive shops and roundhouses and in car shops and repair yards to a basis of eight hours per day on December 9. At roundhouses and other places where the work is continuous 24 hours a day three eight-hour shifts should be established. In shops where a single eight-hour shift will not properly maintain the equipment a second shift should be organized as soon as men can be obtained, pending which the work should be taken care of by necessary overtime in accordance with agreements with the employees.

"It is believed that under present conditions of business with increased force, which is available, that at practically all points shop work can be handled on the eight-hour basis without the necessity of requiring excessive overtime, and every effort should be made to do this."

TO RETAIN SKILLED RAILROAD MEN

The mechanical department of the Division of Operation is taking steps to prevent the possible loss of trained shop employees to the railroad service as a result of any reduction in force which may seem necessary at particular points. If the men are not needed at one place arrangements will be made to locate them elsewhere, as it is believed that more men instead of less men will be needed in the next few weeks. Frank McManamy, assistant director of the Division of Operation, has addressed a letter to the regional directors stating that a number of cases have recently been brought to his attention where in the readjustment of shop forces skilled workmen have been laid off.

"Every trained railroad employee represents a certain definite investment," Mr. McManamy said, "therefore, when reorganizations make reductions in forces necessary, all reasonable efforts should be made to retain these men in railroad service. Before a reduction in force is made at any point, steps should be taken to ascertain if the men to be laid off cannot be profitably used at some other point, either on that line or on some other line within your region, in which event transfer should be made and transportation provided.

"If the men cannot be profitably used in your region, this office should be advised, giving the number of skilled workmen to be released and their occupation, so that efforts may be made to place them elsewhere, thus retaining in railroad service, men who have been trained and are proficient in that line of work."

APPRENTICE SYSTEM MAY BE EXTENDED

Frank McManamy, assistant director of the division of operation of the Railroad Administration, has been designated by the administration to confer with the government Board for Vocational Education on plans for the co-operation of the Railroad Administration in the development and extension of the apprentice system for training railway employees. The board has been in existence for about a year, having been appointed for the purpose of investigating and recommending methods of vocational education. Mr. McManamy, held his first conference with the board early in December.

WAGE INTERPRETATION

Interpretation No. 2, to Supplement No. 7 to General Order No. 27:

Question:—Shall employees coming under the provisions of paragraph (a) Article V, Supplement No. 7 to General Order No. 27, paid on a tonnage or piece-work basis and earning in excess of 43 cents per hour (the maximum rate established) receive any portion of the increase provided for, if thereby such increase would establish a rate in excess of 43 cents per hour.

Decision:—Paragraph (2) Article V of Supplement No. 7 to General Order No. 27 specifically states, "Provided that the maximum shall not exceed 43 cents per hour." Employees paid on a tonnage or piece-work basis whose average hourly earnings, per day period, equal 43 or more cents per hour are therefore not entitled to any portion of the increase, but are guaranteed not less than 43 cents per hour.

The provisions of paragraph (2) Article VIII, Supplement No. 7 to General Order No. 27, protects higher rates and is to be observed.

MATERIAL STANDARDS FOR FREIGHT CAR REPAIRS

Frank McManamy, assistant director of the Division of Operation, has issued Mechanical Department Circular No. 8, prescribing material standards for freight car repairs as follows:

When renewing parts or applying betterments to freight cars owned by the railroads under federal control, if suitable material, either new or second hand, that is standard to the car, is in stock it shall be used. Where such material is not in stock, material standard to United States standard cars should be used if available.

1. *Bolsters*—Body bolsters, when renewals are made, should be either cast steel or built-up type.

Truck Bolsters—When renewals are made should be cast steel box girder type.

2. *Column Castings*—Truck column castings when used should be made of malleable iron or cast steel.

3. *Side Bearings*—If body or truck side bearings require changing or renewing, frictionless type should be used, interchangeable in capacity and dimensions with those used on United States standard cars.

4. *Side Truck Frames*—When necessary to renew side truck frames, cast steel U-shaped section, United States standard car type with separable journal boxes to be used.

5. *Coupler Operating Device*—Coupler operating device to be of type directly connected to coupler knuckle lock without use of clevis, link, chain or pin and to be interchangeable with operating device on United States standard cars where possible.

6. *Draft Gears*—(a) Friction draft gears, either Cardwell, Miner, Murray, Sessions Type "K," Westinghouse or similar gears, of not less than 150,000 lb. capacity with a maximum travel of 2¾ in.

(b) Spring draft gears, if used, to be at least equal in capacity to two M. C. B. Class "G" springs, interchangeable with friction gear without change in car construction.

(c) Clearance between coupler horn and striking casting to be three inches.

(d) Coupler to be key connected to draft gear.

7. *Hand Brakes*—If renewals are required on open top cars, hand brakes should be changed to drop handle type and so located as to be below top of car where construction of car will permit and of a type interchangeable with United States standard cars.

8. *Doors*—Side doors on box or stock cars (except double-deck stock cars) will be bottom supported, the attachments uniform with those on United States standard cars.

9. *Ends*—Box cars with weak constructed ends requiring two-thirds of end to be renewed, should be reconstructed as follows:

(a) Horizontal corrugated steel ends (two or three piece) having top section 3/16 in. thick and bottom section or sections ¼ in. thick and corrugations 2¼ in. deep.

(b) Vertical reinforced ends with four or five-inch Z-bars, securely fastened to place on end sills and end plates. End plates to be diagonally braced on inside of car, under roof, to side plates, or with reinforcements equivalent in strength.

(c) End lining to be 1¾ in. thick, tongued and grooved, extending from floor to end plate, with corners sealed with beveled corner strips 1½ by 1½ in., securely nailed to place to prevent possibility of grain leaks.

10. *Metal Strap to be Applied to Side Sheathing*—Double sheathed box cars will have applied to face of sheathing of car at side sill a small angle iron, channel iron or strap securely bolted in place to insure sheathing being held tight against side sill to prevent grain leakage; bolts to have single nuts and to be riveted over. Location of bolt spacing to be the same as on United States standard cars where practicable. Channel or strap to be painted on back with freight car paint before it is applied.

11. *Grain Door Nailing Strip*—Door post should have grain door nailing strips on inside face (approximately 1½ in. by 3½ in.), full height of door opening securely fastened to place with screws or heavy wire nails.

12. *Roofs*—When roofs are changed or renewed outside flexible type metal roof with mullions between roof sheets and with flexibility at eaves and ridges, made of 22 or 24 gage galvanized iron will be applied. Roofs should be interchangeable with United States standard cars having same length and width sheets. To permit the use of standard sheets, the following changes may be made:

(a) Increase or decrease in thickness, or omitting eave molding, fascia or both.

(b) Increase the width of roof flashing at eaves.

(c) Where cars are equipped with all-metal roofs, such construction may be continued when renewals are necessary, if considered desirable to do so.

13. *Preservation of Material*—When rebuilding or repairing wood or steel cars—On all-wood cars, wood preservative, freight car paint or its equivalent will be applied to all mortises and tenons; ends of posts and braces; and post and brace shoes at sills. Top of all sills will be painted, including face of side and end sills.

(a) On refrigerator cars, sills will be painted all over in addition to the above.

(b) When applying metal parts on outside of wood cars, both the wood and metal part shall be painted before applied, except when applying metal roofs. Before outside metal roof is applied it should be painted on underside.

(c) Steel cars, steel underframes, steel center sills or steel draft arms, when assembling should have red lead applied to the surfaces before one metal part is applied, lapping another.

In complying with the above instructions, it is imperative that careful consideration be given to preservation and reclamation of material. Material removed from one car, in order to standardize such car or a part thereof, fit for further use, shall be reclaimed and used in making repairs to other equipment.

REPAIRS TO FREIGHT CARS

The Division of Operation has issued a revision of Circular No. 20, regarding the limit of cost for repairs to freight cars in which rule No. 7 is changed to read as follows:

"When the cost of repairs in kind exceeds the amount which may be expended and betterments are not to be applied, repairs will not be made. The federal manager, or general manager on roads having no federal manager, will endeavor to secure an agreement with the owning corporation that such cars may be dismantled upon the basis of settlement established in the current Master Car Builders' Association rules. When such agreements have been secured he may authorize in writing that the car will be dismantled. If such an agreement has not been secured the car will not be dismantled, but will be held for disposition and the regional director advised."

DESIGNS FOR PASSENGER CARS

The Committee on Standards of the mechanical department of the Railroad Administration at a meeting in Washington last week agreed upon the floor plan and general designs of the proposed standard 70-ft. passenger coach and the 70-ft. combination passenger, baggage, mail and express cars. The general designs and the specialties selected follow very closely those approved for the proposed standard baggage cars.

ORDERS OF REGIONAL DIRECTORS

Rental Charge for Locomotives.—In Order 126 the Southwestern regional director announces that the rate for the rental of locomotives to industries and small lines has been set at one-tenth cent per pound of tractive power per day, with a minimum of $30 per day. This rate of rental will apply in all cases where locomotives are loaned to any such industries or small lines.

Working Hours in Shops.—In Supplement 1 to Order 141 the Southwestern regional director issued instructions regarding the period to be allowed for meals in roundhouses and other places where three eight-hour shifts are worked. Most of the agreements which are in effect provide for a lunch period of not to exceed 20 minutes, with pay, for men who are working one of the eight-hour shifts. Men who are employed in shops or roundhouses or other places where less than three shifts are worked generally have a meal period of not to exceed one hour without pay. These practices, pending further action by the Railroad Administration, will govern except when more favorable conditions are provided by the agreements in effect.

M. C. B. Brake Shoe Keys.—The Eastern regional director, file 500-70A348, advises that the executive committee of the Master Car Builders' Association calls attention to the fact that a great number of brake shoe keys are being made which do not conform to the Master Car Builders' standard, and which are made, in many cases, of inferior material. The substitute brake shoe keys are of numerous types, with the result that they work down from the lugs of the brake head and shoe, resulting in loss of the shoe and key. Brake shoes should not be applied unless the key is provided with a head, and of sufficient strength for the service, as is shown on Master Car Builders' Sheet No. 17, Volume 51, of the Master Car Builders' Association proceedings.

Placing of Common and Semi-Skilled Labor on an Eight-Hour Basis.—The Eastern regional director, file 1200-4-56A352, states that it has been brought to his attention that in applying Interpretations No. 1 to Supplements Nos. 7 and 8 to General Order No. 27 very substantial increases will be given to the various classes of common labor where heretofore paid on an hourly or daily basis. The indications are that labor conditions will be very much improved within the next week or two, and it appears that this would be an opportune time to place all maintenance of way, common and semi-skilled labor, also other classes of common labor, on an eight-hour basis.

Removal of Coal and Water from Engines.—The Eastern regional director, file No. 500-1-68A336, orders that when engines are moved dead to repair shops it is desired that coal and water be removed before shipment is made.

Violations of Safety Appliance Laws.—In Order 144 the Southwestern regional director states that numerous violations of safety appliance laws and of the director general's order No. 8 are being reported by traveling federal inspectors. He directs that immediate action be taken effectively to stop these violations; car and mechanical department heads should be given to understand that the federal laws and the orders of the director general must be observed.

Car and Locomotive Orders in 1918

The Railroad Administration and the Director General of Military Railways Are the Principal Buyers

The number of locomotives reported as having been ordered during the 12 months of 1918, according to figures compired by the Railway Age, was 4,888, of which 2,802 were on domestic orders for companies in the United States and Canada, and 2,086 were on orders for shipments to other countries. These figures compare with a total in 1917 of 6,142, of which 2,704 were on domestic orders and 3,438 were for export, principally to the war zone in France.

The leading feature in the locomotive market during the past year, as in every other essential industry in the country, was the predominance of government orders. Of the 2,593 locomotives reported as having been ordered for service in the United States (excluding the domestic orders for Canada), no less than 2,030 were included in the orders for standard locomotives placed by the United States Railroad Administration. Of the 209 locomotives ordered for roads in Canada 195, or practically all, were ordered by the Canadian government for the Canadian Government Railways.

Table I—The Locomotive Orders in 1918

Domestic—		
United States Railroad Administration	2,030	
Other railroad orders	525	
Industrials, etc.	38	
Total United States	2,593	
Canadian railroads	209	
Total domestic		2,802
Foreign—		
Director General Military Railroads	1,404	
Other foreign	682	
Total foreign		2,086
Total of all orders		4,888

Of the total of 2,086 locomotives ordered for export, no less than 1,404 were on orders for the United States military railroads, this figure excluding those orders that were cancelled after the signing of the armistice. The remainder of the orders for export also included a considerable number of locomotives for foreign governments—South Africa, England, Chili, China, Italy, etc.

The number of locomotives ordered for domestic service in 1918, inclusive of the Canadian orders, as will be seen from Table II, was greater than last year but not as great as 1916. It was greater than the totals of domestic orders in 1914 and 1915, which were poor years. It was only about 1,700 less than in 1912 and bears no comparison whatever to the big totals of 1905 and 1906. The orders for export were likewise not as great as in 1917. They bade fair to be much the same as those of that year, but the signing of the armistice put an end to the placing of further orders for the United States military railroads and resulted in cancellations of orders already placed, amounting to 1,500, in the latter part of November.

Table II—Domestic Orders for Locomotives Since 1901

Year	Locomotives	Year	Locomotives
1901	4,340	1910	3,787
1902	4,665	1911	2,850
1903	3,283	1912	4,515
1904	2,538	1913	3,467
1905	6,265	1914	1,265
1906	5,642	1915	1,612
1907	3,482	1916	2,910
1908	1,182	1917	2,704
1909	3,350	1918	2,802

Table III gives a resumé of the standard locomotives delivered to December 21, 1918. It will be noted from this table that the American Locomotive Company produced by far the larger proportion of the 678 that had been completed to date. The Baldwin Locomotive Works, which produced only 112, was engaged for several months almost entirely

Table III—Standard Locomotives Delivered to Dec. 21

Alabama & W. Point & Western Ry. of Ala.	2		0-8-0.....American
Atlantic Coast Line	5		0-6-0.....American
Baltimore & Ohio	50	Light	2-8-2.....Baldwin
Central of New Jersey	10		0-6-0.....American
	10	Heavy	2-8-2.....American
Chicago & Alton	10	Light	2-8-2.....American
Chicago Junction	14		0-6-0.....American
Chicago & Eastern Illinois	15	Light	2-8-2.....American
Chicago Great Western	10	Light	2-8-2.....Baldwin
Chicago, Milwaukee & St. Paul	50	Heavy	2-8-2.....American
Cleveland, Cincinnati, Chicago & St. Louis	25	Light	2-8-2.....Baldwin
El Paso & Southwestern	5	Heavy	2-8-2.....American
Erie	16		0-8-0.....American
	15	Heavy	2-8-2.....American
Grand Trunk Western	16	Light	2-8-2.....American
Grand Trunk—East	15	Light	2-8-2.....American
Lake Erie & Western	15	Light	2-8-2.....Baldwin
Lehigh & Hudson River	4	Light	2-8-2.....Baldwin
Louisville & Nashville	20	Heavy	2-8-2.....American
Michigan Central	20	Light	2-8-2.....American
Nashville, Chattanooga & St. Louis	10	Light	2-8-2.....American
New York Central	33	Light	2-8-2.....Lima
	25		0-8-0.....American
	50	Light	2-8-2.....American
New York, Chicago & St. Louis	10	Light	2-8-2.....American
Pennsylvania Lines West	17		0-6-0.....American
Pittsburgh & West Virginia	3	Light	2-8-2.....Baldwin
Pittsburgh, McKeesport & Youghiogheny	10	Heavy	2-8-2.....American
Rutland	2		0-8-0.....American
	6	Light	2-8-2.....American
Seaboard Air Line	4		0-6-0.....American
	10	Light	2-8-2.....American
Southern	20		0-8-0.....American
	25	Light	2-8-2.....American
	29	Light	2-10-2....American
Terminal R. R. of St. Louis	6		0-6-0.....American
Texas & Pacific	11	Light	2-8-2.....American
Toledo & Ohio Central	5		0-8-0.....American
	15	Light	2-8-2.....American
Union Pacific	20	Light	2-8-2.....American
Wabash	20	Light	2-8-2.....American
Western Pacific	5	Light	2-8-2.....Baldwin
Wheeling & Lake Erie	5		0-8-0.....American
	10	Heavy	2-8-2.....American

Total—Six-wheel switching, American		56
Eight-wheel switching, American		75
Light Mikado, American	253	
Baldwin	112	
Lima	33	
		398
Heavy Mikado, American		120
Light Santa Fe, American		29
Total to December 21		678

on locomotives for the United States Military Railroads overseas.

LOCOMOTIVE PRODUCTION IN 1918

The total number of locomotives produced in 1918 was 6,475, including 3,668 on domestic orders and 2,807 on orders for the United States military railroads and for other railroads outside the United States and Canada. This total

Table IV—The Locomotives Built

Domestic	3,668
Foreign	2,807
Total	6,475

Comparison with Previous Years

Year	Domestic	Foreign	Total	Year	Domestic	Foreign	Total
1896	866	309	1,175	1907*	6,564	798	7,362
1897	865	386	1,251	1908*	1,886	456	2,342
1898	1,321	554	1,875	1909*	2,596	291	2,887
1899	1,951	514	2,475	1910*	4,441	314	4,755
1900	2,648	505	3,153	1911*	3,143	387	3,530
1901	.....	...	3,384	1912†	4,403	512	4,915
1902	.....	...	4,070	1913†	4,561	771	5,332
1903	.....	...	5,152	1914†	1,962	273	2,235
1904	.....	...	3,441	1915†	1,250	835	2,085
1905*	4,896	595	5,491	1916†	2,708	1,367	4,075
1906*	6,232	720	6,952	1917†	2,585	2,861	5,446
				1918†	3,668	2,807	6,475

* Includes Canadian output.
† Includes Canadian output and equipment built in railroad shops.

compares with a total of 5,446 in 1917, of which 2,585 were for domestic service and 2,861 for export. In spite of the high rate of production which was attained at various times during the year the total was not as great as in the peak years of 1906 and 1907, when 6,952 and 7,362 locomotives were produced respectively.

FREIGHT CARS ORDERED IN 1918

Because of the 100,000 standard freight cars ordered by the United States Railroad Administration in 1918, of which, however, only about 12 per cent had been delivered to the end of December, the orders for freight cars in 1918 for domestic service in the United States and Canada were considerably in excess of those of 1917. They were not, however, as great as those of 1916, were only half those of 1912,

Table V—The Freight Car Orders in 1918

Domestic—		
United States Administration	100,000	
United States Army or Navy	740	
Other railroad orders	1,227	
Private car lines and industrials	12,146	
Total United States	114,113	
Canadian railroads	9,657	
Total domestic		123,770
Foreign—		
Director General Military Railroads	36,875	
Other foreign	16,672	
Total foreign		53,547
Total of all orders		177,317

and did not compare at all with those of the big years 1905 and 1906.

The orders for freight cars in 1918 totaled 177,317, of which 123,770 were on domestic orders and 53,547 were on foreign orders, principally for the United States Military Railroads in France. The orders in 1917 totaled 131,558 (excluding the 30,500 Russian cars which were cancelled), of which 79,367 cars were for domestic service and 34,167 were for export, principally for France and the Military Railroads.

The passenger car orders for 1918 were practically non-existent, war-time activities and presumably the omnipresent government desire for standardization not permitting the placing of such orders. The orders for passenger cars

Table VI—The Passenger Car Orders of 1918

Domestic, United States and Canada	131
Foreign	26
Total	157

totaled only 157, including 131 for domestic service and 26 for export, as compared with 1,167 in 1917, of which 1,124 were for domestic service, 6 for the United States Government and 37 for export.

As in the case of locomotives, the predominating feature during the past year, insofar as the orders for freight cars were concerned, was the great proportion the government purchases held to the total orders. Unlike 1917, there were few orders from governments of other countries. The government orders referred to were those placed by our own authorities, either the United States Railroad Administration or the Director General Military Railroads.

Table VII—Domestic Orders for Cars Since 1901

	Freight cars	Passenger cars		Freight cars	Passenger cars
1901	193,439	2,879	1910	141,024	3,881
1902	195,248	3,459	1911	133,117	2,623
1903	108,936	2,310	1912	234,758	3,642
1904	136,561	2,213	1913	146,732	3,179
1905	341,315	3,289	1914	80,264	2,002
1906	310,315	3,402	1915	109,792	3,101
1907	151,711	1,791	1916	170,054	2,544
1908	62,669	1,319	1917	79,367	1,167
1909	189,360	4,514	1918	123,770	131

The year opened very auspiciously with prospects for heavy orders from the railroads, which were soon dispelled with the announcement that purchases for our own railroads would be centralized and placed by the Railroad Administration. It was not until April, however, that orders for 100,000 standard cars were placed, divided as follows:

25,000	40-ton double sheathed box.
25,000	50-ton single sheathed box.
20,000	50-ton composite gondola.
5,000	70-ton low side gondola.
25,000	55-ton hopper.
100,000	

Quantity production on these orders was promised by the Railroad Administration for August, but was not reached until November, and up to December 21, the latest date for which figures are available at this writing, only 11,815 have been delivered.

The orders placed by the Director General Military Railroads totaled 36,875. The first orders this year were in February and totaled about 5,000. In July an order for 10,000 additional was divided among several builders, and

Table VIII—Freight and Passenger Cars Built

	1918 Freight	1918 Passenger
Domestic	81,767	1,481
Foreign	42,941	92
	124,708	1,573

Comparison with Previous Years

Year	Freight Domestic	Freight Foreign	Freight Total	Passenger Domestic	Passenger Foreign	Passenger Total
1899	117,982	1,904	119,886	1,201	104	1,305
1900	113,070	2,561	115,631	1,515	121	1,636
1901	132,591	4,359	136,950	1,949	106	2,055
1902	161,747	2,800	162,599	From 1902 to 1907		1,948
1903	153,195	1,613	152,801	passenger car fig-		2,007
1904	60,955	1,995	60,806	ures in these two		2,144
1905*	162,701	5,305	165,155	columns included		2,551
1906*	236,451	7,219	240,503	in corresponding		3,167
1907*	280,216	9,429	284,188	frt. car columns.		5,457
1908*	75,344	1,211	76,555	1,645	71	1,716
1909*	91,077	2,493	93,570	2,698	151	2,849
1910*	176,374	4,571	180,945	4,136	276	4,412
1911*	68,961	3,200	72,161	3,938	308	4,246
1912†	148,357	4,072	152,429	2,822	238	3,060
1913†	198,066	9,618	207,684	3,076	220	3,296
1914†	....	.....	104,541	.....	...	3,691
1915†	59,984	14,128	74,112	1,935	14	1,949
1916†	113,692	21,309	135,001	1,769	70	1,839
1917†	119,363	32,038	151,401	1,969	31	2,000
1918†	81,767	42,941	124,708	1,481	92	1,573

* Includes Canadian output.
† Includes Canadian output and equipment built in company shops.

was shortly afterward supplemented by 20,000 more. In September an additional 40,000 cars were ordered, but immediately following the signing of the armistice this last 40,000 was cancelled before production had been begun on them. Table IX, giving a resumé of the orders on hand at the various car building plants of the country as of November 1, contains a column showing the status of the military orders on that date—that is, before any cancellations had taken place. From that column it will be seen that there were then outstanding orders for 85,834 cars. There had been shipped

Table X—Standard Car Deliveries to December 21

Atlantic Coast Line	50	50-ton Gondola..Am. Car & Fdy.
	250	50-ton Gondola..Pressed Steel
Bessemer & Lake Erie	250	55-ton Hopper...Am. Car & Fdy.
	250	55-ton Hopper...Standard Steel
Buffalo, Rochester & Pittsburgh	500	55-ton Hopper...Pressed Steel
	300	55-ton Hopper...Pullman
Carolina, Clinchfield & Ohio	250	55-ton Hopper...Standard Steel
	250	55-ton Hopper...Am. Car & Fdy.
	250	55-ton Hopper...Pressed Steel
Chicago & North Western	1,250	40-ton Box......Am. Car & Fdy.
	217	50-ton Box......Am. Car & Fdy.
	10	50-ton Box......Haskell & Barker
	500	50-ton Gondola..Am. Car & Fdy.
	500	50-ton Gondola..Haskell & Barker
Chicago, Burlington & Quincy	422	40-ton Box......Am. Car & Fdy.
Charleston & Western Carolina	10	40-ton Box......Am. Car & Fdy.
Cleve., Cin., Chicago & St. Louis	81	40-ton Box......Am. Car & Fdy.
	200	55-ton Hopper...Am. Car. & Fdy.
	200	55-ton Hopper...Pressed Steel
	200	55-ton Hopper...Pullman
	200	55-ton Hopper...Ralston
	200	55-ton Hopper...Standard Steel
Georgia	100	50-ton Gondola..Pressed Steel
Kanawha & Michigan	300	55-ton Hopper...Pressed Steel
	200	55-ton Hopper...Ralston
Michigan Central	86	50-ton Gondola..Am. Car & Fdy.
	200	50-ton Gondola..Haskell & Barker
	200	50-ton Gondola..Pressed Steel
	200	50-ton Gondola..Standard Steel
Missouri Pacific	16	40-ton Box......Am. Car & Fdy.
New York Central	500	40-ton Box......Am. Car & Fdy.
	423	50-ton Gondola..Am. Car & Fdy.
	500	50-ton Gondola..Pressed Steel
	500	55-ton Hopper...Pressed Steel
	500	55-ton Hopper...Standard Steel
New York, New Haven & Hart.	357	55-ton Hopper...Pressed Steel
	500	55-ton Hopper...Pullman
	200	55-ton Hopper...Ralston
	400	55-ton Hopper...Standard Steel
Toledo & Ohio Central	293	55-ton Hopper...Am. Car & Fdy.
Total	2,279	40-ton Box
	3,009	50-ton Gondola
	6,300	55-ton Hopper
	227	50-ton Box
	11,815	to December 21

on these orders 2,575 cars, leaving 83,259 to be delivered These figures are also to be shown as follows:

Total of All Cars Ordered by the United States Military Railroads from the Time the United States Entered the War to November 1, 1918.

	Ordered	Shipped	Remaining to be shipped
Standard gage cars	98,069	19,395	78,674
Narrow gage cars	8,579	3,994	4,585
Total of *all* military cars ordered	106,648	23,389	83,259

Figures for standard gage cars include 6,000 sets box car metallics ordered by military railroads and 36 shuttle cars and 73 mortar cars ordered by the ordnance department.

Table IX—A Resumé of the Freight Car Orders on Hand on November 1

	Total on order November 1	U. S. military roads	Allied and neutral	Private lines and corporations	Army and navy	Railroad Administration	Total foreign	Total domestic
American Car & Foundry Co.	66,465	17,684	14,236	2,928	617	31,000	31,920	34,545
Bettendorf Co.	4,034	1,000	....	....	34	3,000	1,000	3,034
Cambria Steel Co.	7,036	1,120	....	2,916	....	3,000	1,120	5,916
Chicago Steel Car Co.	256	....	....	256	....	....	....	256
General American Tank Car Co.	4,386	1,425	....	2,706	255	....	1,425	2,961
Haskell & Barker Car Co.	18,450	10,450	....	....	....	8,000	10,450	8,000
Keith Car & Manufacturing Co.	6,000	1,150	3,000	350	....	1,500	4,150	1,850
Keith Railway Equipment Co.	500	500	....	....	....	....	500	....
Kilbourne & Jacobs Manufacturing Co.	280	280	....	....	....	....	280	....
Koppel Industrial Car Co.	800	800	....	....	....	....	800	....
Laconia Car Co.	1,150	....	....	150	....	1,000	....	1,150
Lakewood Engineering Co.	387	387	....	....	....	....	387	....
Lenoir Car Co.	3,000	....	....	1,000	....	2,000	....	3,000
Liberty Car & Equipment Co.	3,150	2,150	....	....	....	1,000	2,150	1,000
McGuire-Cummings Manufacturing Co.	500	....	....	....	....	500	....	500
Magor Car Co.	2,808	749	1,035	20	4	1,000	1,784	1,024
Mt. Vernon Car Manufacturing Co.	7,209	1,200	500	1,509	....	4,000	1,700	5,509
Pacific Car & Foundry Co.	2,390	....	....	388	2	2,000	....	2,390
Pacific Tank Car Co.	949	660	....	289	....	....	660	289
Pressed Steel Car Co.	25,860	10,875	220	761	4	14,000	11,095	14,765
Pullman Co.	19,909	7,709	3,200	1,000	....	8,000	10,909	9,000
Ralston Steel Car Co.	5,400	1,400	....	....	....	4,000	1,400	4,000
St. Louis Car Co.	2,750	1,750	....	....	....	1,000	1,750	1,000
Standard Car Const. Co.	2,923	2,100	....	823	....	....	2,100	823
Standard Steel Car Co.	48,094	21,745	9,134	2,125	....	15,000	30,879	17,215
Western Wheeled Scraper Co.	928	700	....	228	....	....	700	228
Total cars on order November 1	235,614	85,834	31,325	17,539	916	100,000	117,159	118,455
On November 1 there had been shipped on these orders	20,400	2,575	6,368	8,463	252	2,742	8,943	11,457
Leaving to be shipped	215,214	83,259	24,957	9,076	664	97,258	108,216	106,998

These military cars have been an important factor in the year's business, but they have not been sufficient to impede the production of other cars, and it cannot be said that the car building plants have been particularly rushed at any time.

The resumé of freight car orders on hand on November 1 shows a total of 235,614 cars, of which only 20,400 had been delivered, leaving a total of 215,214 still to be delivered, divided about evenly between foreign and domestic orders. This total represents nearly double as many cars as have on the average been produced annually for the past five years inclusive of 1918. Even with the elimination of such orders for the United States Military Railroads as have been cancelled since November 1, the indications for a big year from the production standpoint in 1919 are very favorable.

The largest single order remaining is, of course, that of 100,000 cars for the United States Railroad Administration. As of November 1, only 2,742 of these cars had been delivered, a figure which had been brought up on December 21 to 11,815. The table headed Standard Car Deliveries to December 21, 1918, will show to what railroads these cars have gone.

FREIGHT CAR PRODUCTION IN 1918

The number of freight cars built in 1918, as shown in one of the tables, totaled 124,708, of which 81,767 were on domestic orders and 42,941 for the United States Military Railroads, or for other foreign service. The total production for 1918 was less than in 1917, when 151,401 cars were produced, of which 119,363 were for domestic and 32,038 were for foreign service. From the standpoint of domestic production, 1918 was one of the low years in the period from 1899 to date, but the production of cars for foreign service was by far the largest yet reported.

The production of passenger cars in 1918 was very low, the total of 1,573 being the lowest since 1901.

Northern Pacific Builds Box Cars

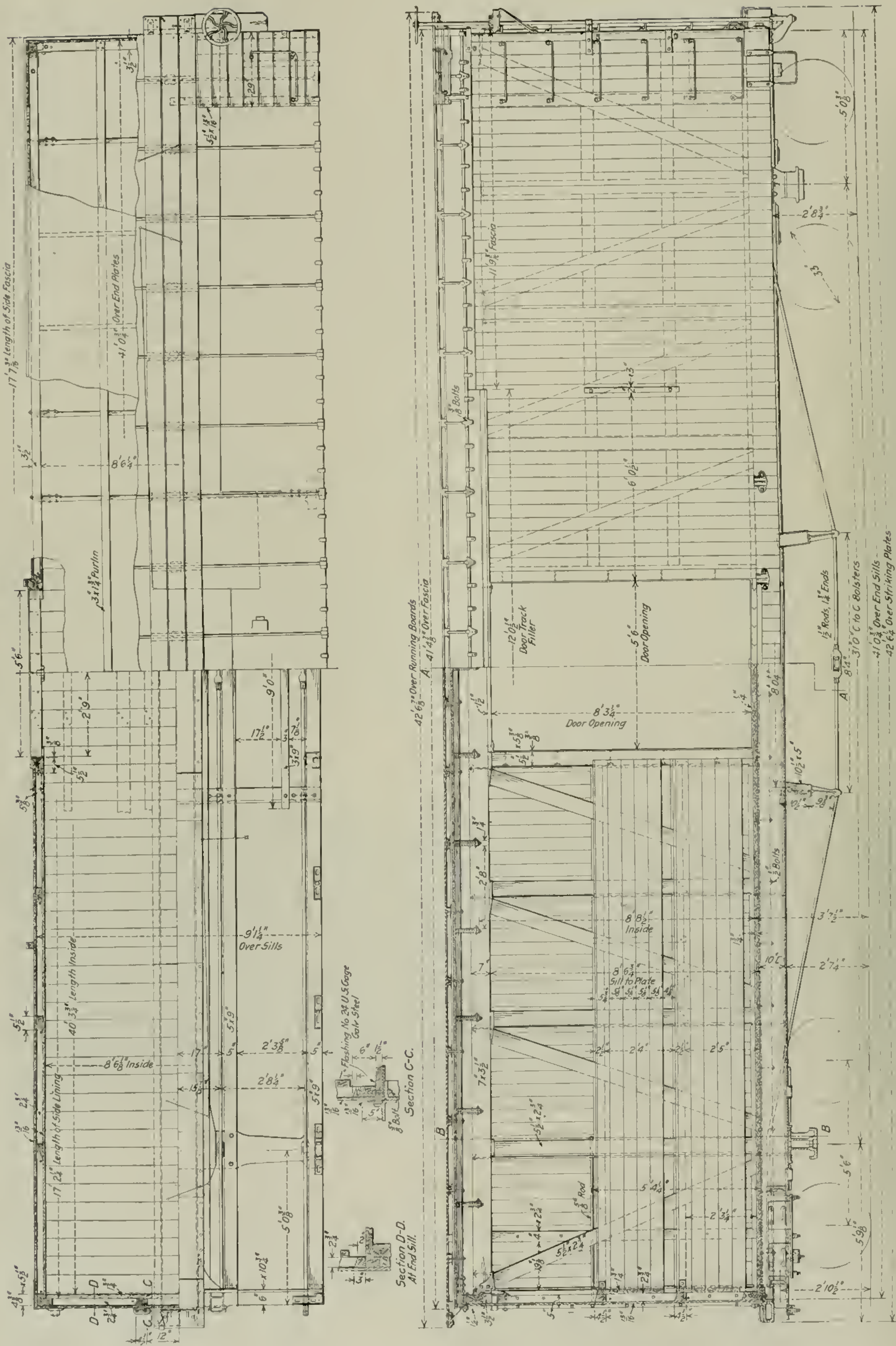
Interesting Design of Underframe and End on Cars Now Being Constructed in Company Shops

The necessity for saving steel in freight cars in every way possible, on account of the large numbers constructed, was quite generally realized during the war. The abnormal shortage in the supply of bars and plates resulted in many interesting designs of rolling stock being brought out. The extent to which wood can well be used varies, of course, with the type of car. The problem under war conditions was to keep down the amount of steel and at the same time provide a car that would not require much labor for upkeep. Man power was as essential as steel in the great conflict. For that reason it was not advisable to save a small amount of steel in building a car that would waste labor as long as it was kept in service.

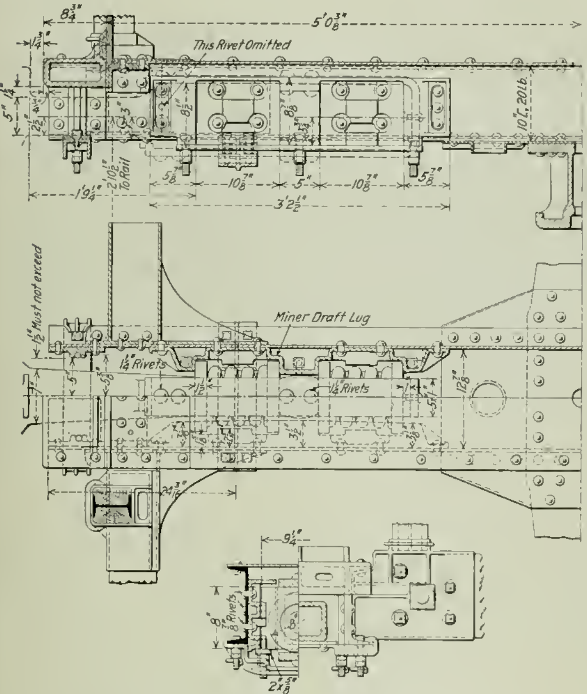
Northern Pacific Box Car of Wood Construction With Steel Center Sills and End Posts.

A good example of a car in which wooden construction is supplemented by the use of a moderate amount of steel in the parts where it is required to enable the equipment to withstand the present severe service conditions, is found in an order of 1,000 box cars of 80,000 lb. capacity now being built by the Northern Pacific. These cars are being constructed at eight different shops on the system where the necessary facilities are available and the building is being carried on as the regular work permits. The use of steel in these cars is confined almost entirely to the center sills and end posts. The cars are 41 ft. ¾ in. long over the end sills, 13 ft. 5½ in. from the rail to the top of the running board and 9 ft. 5⅜ in. wide over the eaves. They have a capacity of 2,990 cu. ft. and weigh 38,600 lb.

The underframe consists of a combination of a steel center sill with wooden side and intermediate sills and truss rods. The center sill is built up of two 10-in. 20-lb. channels, extending continuously the entire length of the car, with top and bottom cover plates. At each end of the channels there is a ¼-in. by 18⅜-in. top cover plate 11ft. ⅜ in. long and above the needle beams there are tie plates ¼ in. by 18⅜ in. by 18 in. On the under side the channels are reinforced for the entire distance between the rear draft lugs. At the center there is a ¼-in. by 18⅜-in. bottom cover plate 25 ft. 6 in. long, while at each end there is a diamond shaped bolster and center sill gusset plate with flanged edges which furnishes diagonal bracing for the body bolster. The draft lugs are of malleable iron of the Miner double pocket type arranged to house two M. C. B. class G springs. The center



Side Elevation and Plan of Northern Pacific Box Car line of draft is three inches from the bottom of the center sill channels. Sharon couplers with 5-in. by 7-in. shanks are used. The buffer castings are of cast steel riveted between the center sill channels and reinforced by a forged angle rivited to the cover plate and sills. The buffer castings and carrier irons are designed to permit the future application of a coupler with a 6-in. by 8-in. shank if desired. In order to bring the 5-in. by 7-in. shank coupler to the proper height a ½-in. filler plate is riveted to the top of the malleable carrier iron. By replacing these plates when worn the standard coupler height can readily be maintained.

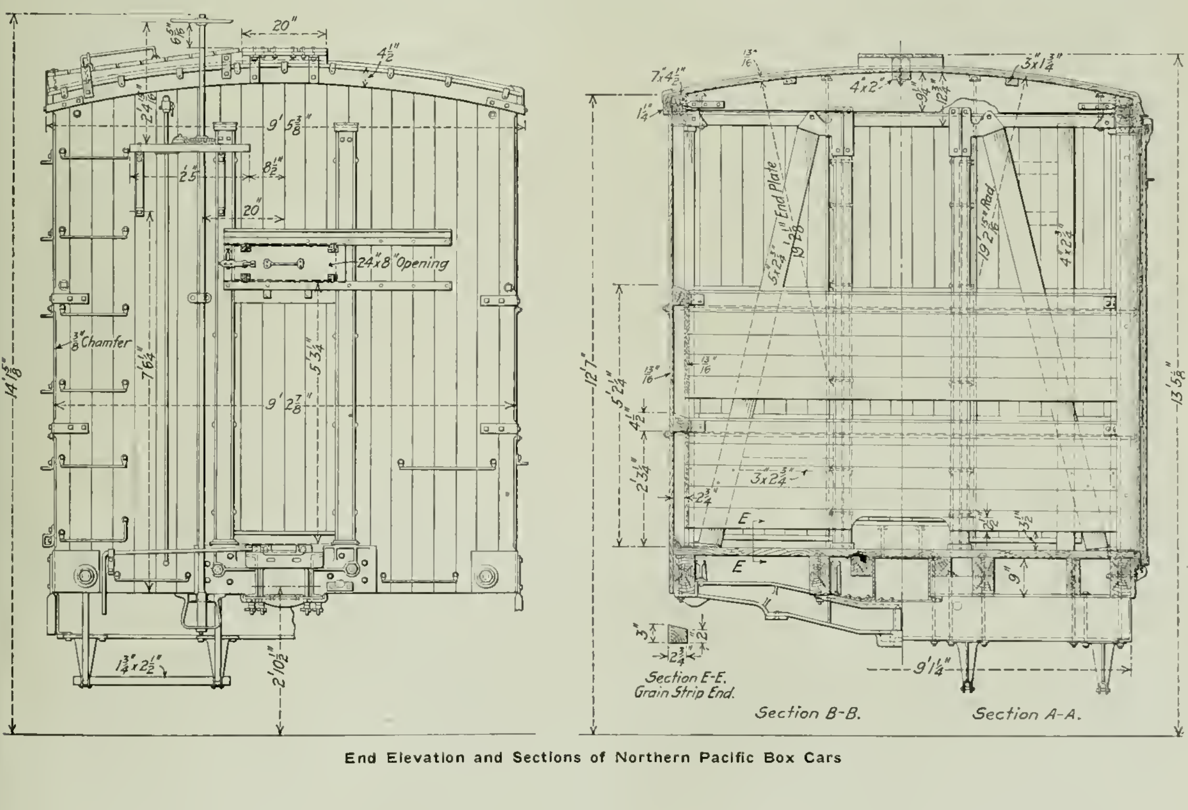


Details of Center Sill End and Draft Rigging

As the side sills are not elevated above the level of the center sills, a continuous end sill cannot be used. The two parts of the end sills, which are of a 6 in. by 10¾ in. section, are fitted into malleable iron castings riveted to the outside of the center sill channels, as shown in the detail drawing of the draft rigging. The two center end posts fit into pockets in these castings. The end sills have pockets bolted to them into which the four 5-in. by 9-in. longitudinal sills are fitted. The sills are supported by the cast steel body bolster, which extends under the center sill, and by two needle beams spaced 8 ft. apart. Just inside of each sill there is a 1½-in. truss rod with 1¾-in. upset ends. In order to strengthen the floor at the door openings, two 3-in. by 9-in. sills, extending 3 in. beyond the needle beams, have been located 7⅛ in. from the side sills. The sills, and all other wooden parts of the car as well, are of fir.

The end framing of the car consists of 4⅜-in. by 5-in. wooden corner posts and two intermediate posts made up of a 5-in. I-beam with wooden fillers on each side. These posts fit into pockets in the castings on the center sills, as already mentioned, and are gained on each side to receive the siding. The upper ends of the posts are set into castings bolted to the end plates into which the 2¾-in. by 5½-in. diagonal braces are also fitted. At one end of the car there is a sliding door 8 in. high and 24 in. wide, 5 ft. 3¼ in. from the floor. The end and side doors have Camel fixtures.

The side framing is made up of 2¾-in. by 5½-in. posts and braces. The door posts are 5½ in. by 5⅜ in. and are reinforced with a 5-in. by ⅜-in. plate flanged against the underside of the side plates and flooring. All the body rods are ⅝ in. in diameter with ends upset to ¾ in. The siding



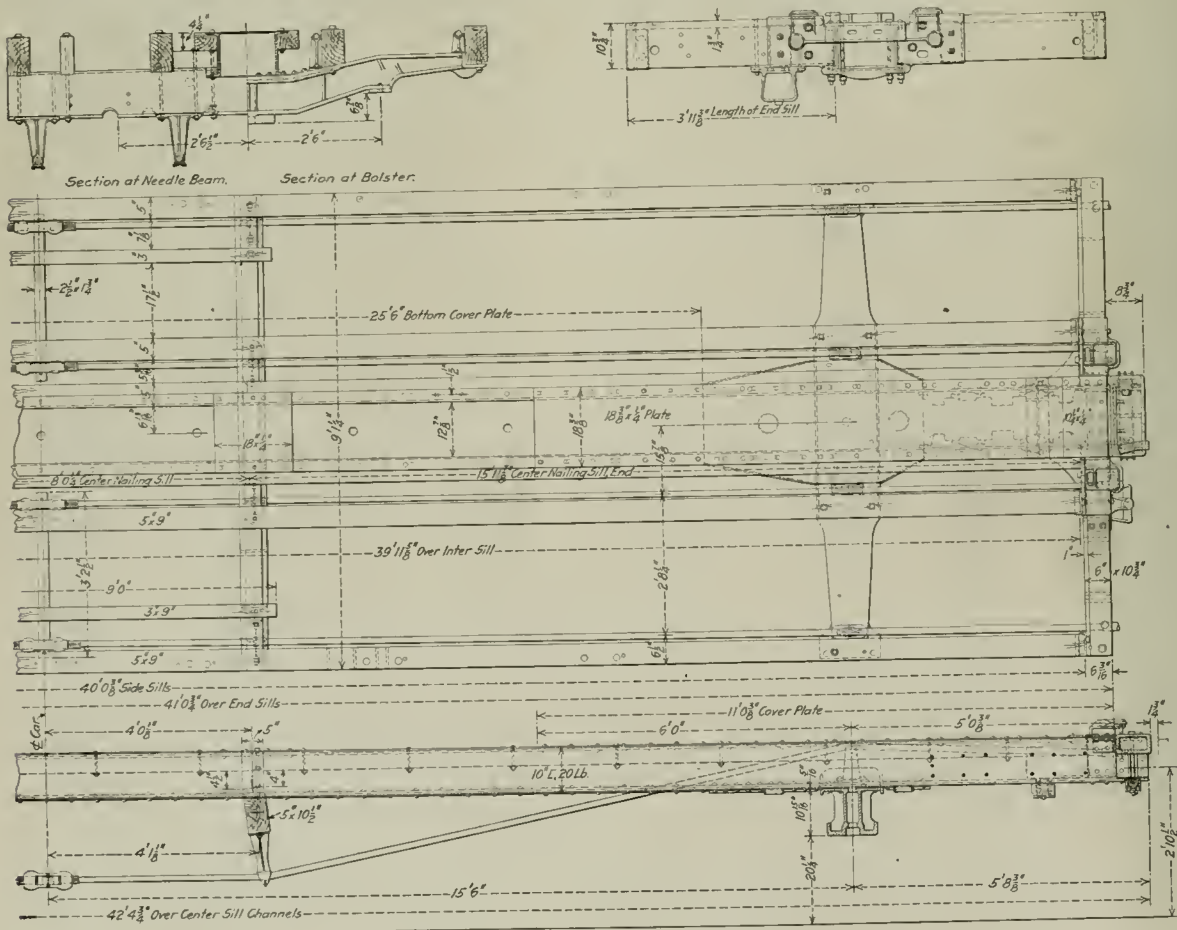
End Elevation and Sections of Northern Pacific Box Cars and the lining are 13/16 in. thick tongued and grooved with the exception of the end lining where 1¾-in. material has been used. There are two belt rails spaced 2 ft. 3¼ in. and 4 ft. 9¾ in. above the floor of a 4½-in. by 2¾ in. section beveled to 3½ in. by 2¾ in. The flooring is 1¾ in. thick, tongued and grooved. Two nailing strips bolted under the top flanges of the center sills, are provided to furnish support for the floor in addition to that given by the sills. The end sill construction makes it necessary to provide special means for insuring that the ends of the car will be grain tight. This is accomplished at the sides by gaining the end sills to receive the flooring. Between the center posts the flooring is laid on the cover plates and the siding is laid up along the edge of the floor. A high grain strip with a flashing of 24 gage galvanized steel under it is bolted into the corner and a filler is nailed between the siding and the rib on the buffer casting, as shown in section *C-C*.

The roof is supported on wooden carlines 1¾ in. wide and 9¼ in. high at the center, tenoned into the side plates. The roof is curved with a radius of 19 ft. 3 in. The roof boards are 13/16 in. tongued and grooved, laid diagonally and continuous from side plate to side plate. An outside metal roof built to Northern Pacific specifications is applied over them.

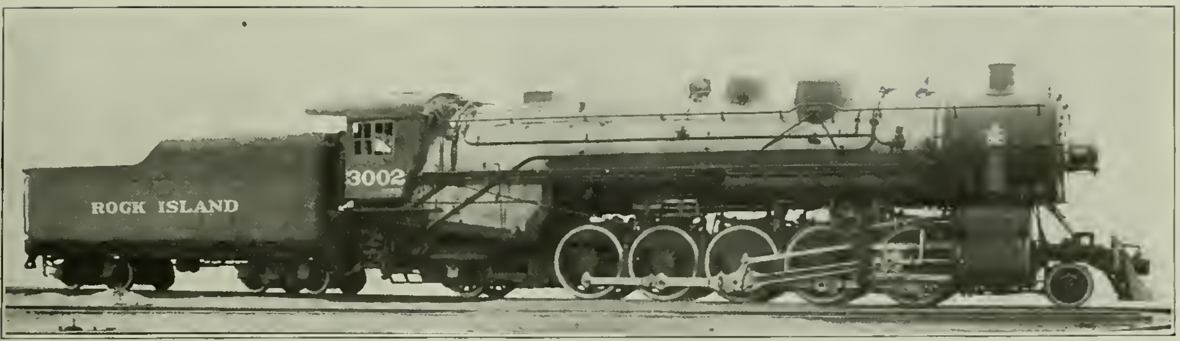
The brake equipment is the Westinghouse Air Brake Company's schedule KC-1012. In connecting the hand brake, the hand brake rod is fastened to one end of an increaser lever, which is fulcrumed at the other end and from an intermediate point is connected to the end of the cylinder push rod by a chain, giving a power ratio of five to two. Trucks of the Bettendorf type with chilled iron

End View of Northern Pacific Box Car

wheels are used under these cars. They are fitted with Barber lateral rollers and Stucki type *C* side bearing. No. 2 brake beams are used and an angle iron safety holder is bolted under the spring plank.



Underframe for the Northern Pacific Box Car

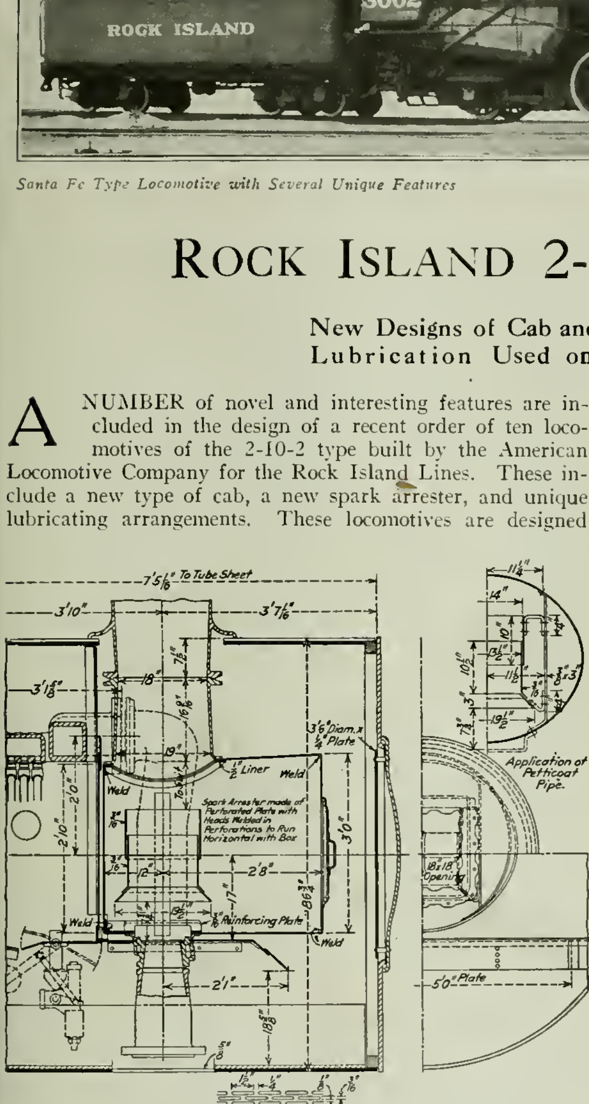


Santa Fe Type Locomotive with Several Unique Features

Rock Island 2-10-2 Locomotive

New Designs of Cab and Spark Arrester; Grease Lubrication Used on Crossheads and Trailer

A NUMBER of novel and interesting features are included in the design of a recent order of ten locomotives of the 2-10-2 type built by the American Locomotive Company for the Rock Island Lines. These include a new type of cab, a new spark arrester, and unique lubricating arrangements. These locomotives are designed

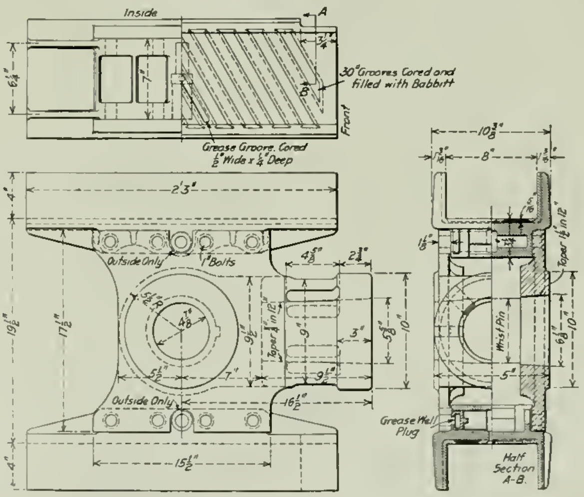


Front End of the Rock Island 2-10-2 Type Locomotives with the Security Spark Arrester.

for a load of 60,000 lb. on each pair of drivers. They are intended to traverse 16 deg. curves and have lateral motion driving boxes on the front axle. Both the front and rear pairs of driving wheels are fitted with Detroit flange lubricators.

The clearances permitted the application of a boiler of large capacity. The boiler horsepower is 96.2 per cent of the cylinder horsepower rating. In the design of the boiler few innovations have been introduced. It is of the conical extended wagon top type with a 5-ft. 4-in. combustion chamber and tubes and flues 2¼-in. and 5½-in. in diameter respectively, 21 ft. 3 in. long. A type *A* superheater with 46 units is applied. The firebox has a Security arch and is fired by a Duplex stoker. The grates are operated by the Franklin power grate shaker.

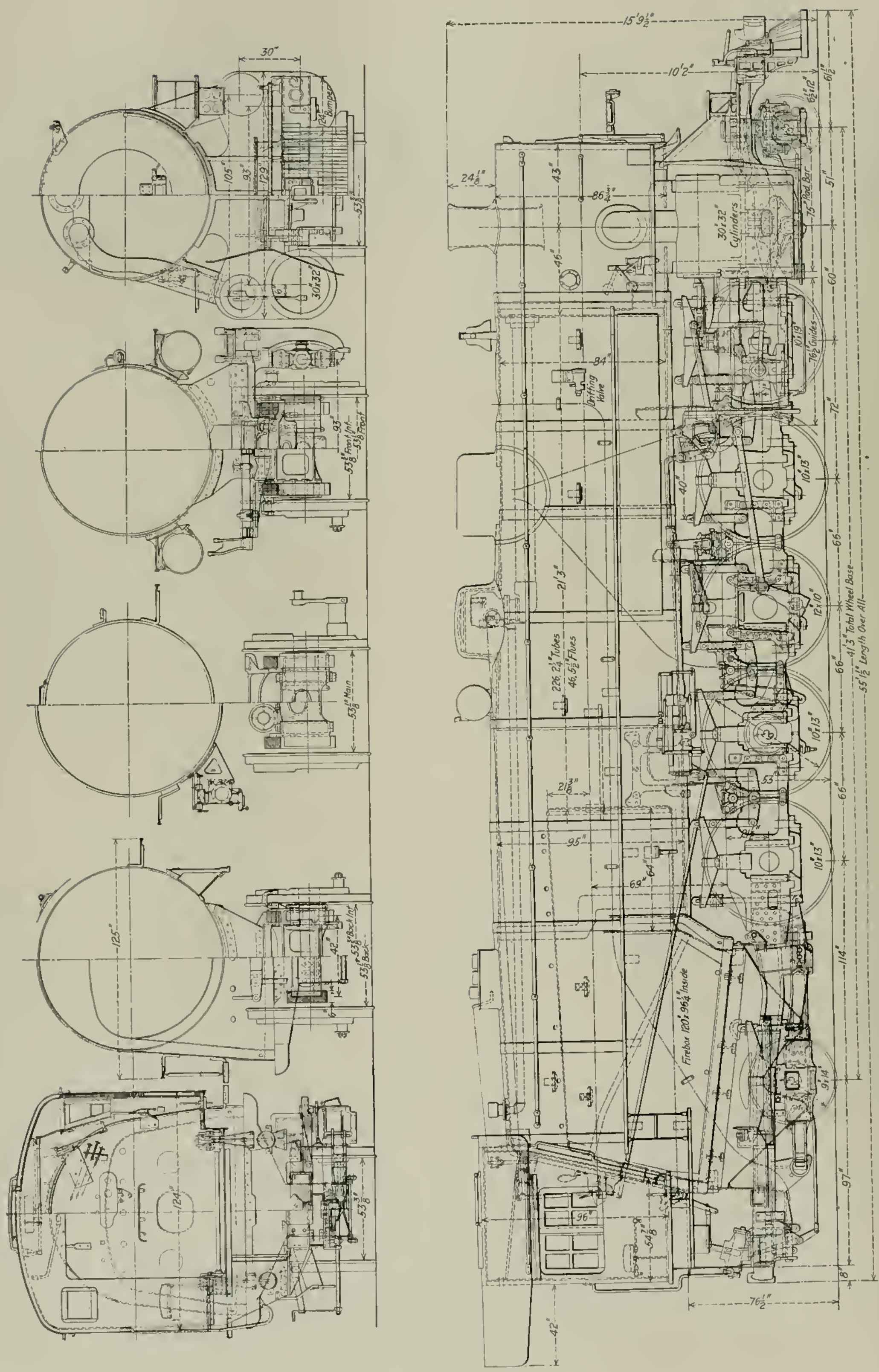
The Security spark arrester which has been in use for several years on the Rock Island Lines is used. This consists of a cylindrical or truncated conical box made of perforated plate or netting, closed at both ends and set between the nozzle stand and the stack extension. The box is reinforced around the openings where it is fastened to these parts. The petticoat pipe is supported on two braces inside the box. At the outer end a sliding door is provided which permits of readily inspecting the box or doing any work inside it. The entire box can be inserted or removed through the smoke-box door. The spark arrester is supported



Crosshead for the Rock Island 2-10-2 Type Locomotives

entirely between the nozzle stand and stack extension. The arrangement of the front end is clearly shown in the illustration.

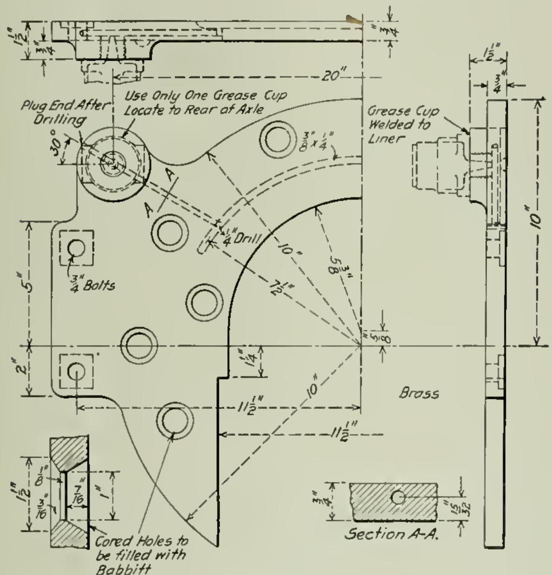
Several months ago the Rock Island applied a new type of cab to a Mikado locomotive. It proved so satisfactory that a similar design is being used on all new power. The front wall of the cab, instead of being vertical, is sloped at



Elevation and Sections of Rock Island 2-10-2 Type Locomotive the same angle as the back-head of the boiler and is set so that it projects forward only a few inches beyond the back-head. With this arrangement all the staybolts in the wrapper sheet are readily accessible for inspection or repairs. The angle of vision through the front cab window is also increased. The front part of the cab, which is eliminated in this design, serves no useful purpose but offers an opportunity for dirt to collect.

The main valves are of the piston type, 14 in. in diameter, and are operated by the Baker valve gear controlled by the Mellin power reverse. The valve chamber and cylinder bushings and piston and valve packing rings are of Hunt-Spiller gun iron. The piston rod packing is of the King type. The Nathan Manufacturing Company's drifting valve is used. A McCord force feed lubricator supplies oil to the valves and the lubrication of the air pump and stoker is provided for by the use of a Nathan two-pint two-feed hydrostatic lubricator.

A departure from the usual practice is the application of grease lubrication to the crossheads and trailer box hub-liners, both of which are illustrated below. The crosshead gibs are of gun iron with recesses in the wearing surfaces filled with babbitt. Grease is fed from a well at the center through a single hole to a groove extending across the face



Trailer Box Hub Liner.

of the gib. The hub-liner on the trailer box is fitted with two lugs to one of which is welded a grease cup. The cup feeds grease to the hub-face at a point behind the center line. An annular groove is provided to facilitate the passage of the lubricant.

The ashpan extends out several inches beyond the sides of the firebox and is flanged upward to the level of the mud-ring. This gives a large air opening and at the same time keeps live coals from falling out or being blown out at the sides of the pan. Electric welding has been used to some extent in the construction of the boiler. The door hole is welded, the sheets being flanged inward and welded together. The firebox sheets are also welded to the mudring at the corners.

The tender used with these locomotives has a flanged bottom and is similar to the design recently described in these columns.* It is carried on a cast steel frame. The air connections between the locomotive and the tender are made with Barco flexible metallic joints of the 3V type.

Among the specialties not already mentioned applied to these locomotives are Westinghouse *ET* No. 6 brakes with an 8½-in. cross-compound compressor, Commonwealth locomotive cradle castings, Miner *A*-18 draft gear, Chambers throttle valves, Pyle-National headlights, Economy radial buffers, Nathan non-lifting injectors, Sellers coal sprinklers, Ashton safety valves and Viloco *II* double type sander.

The principal dimensions, weights and ratios are given below:

General Data	
Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bituminous coal
Tractive effort	71,900 lb.
Weight in working order	383,000 lb.
Weight on drivers	302,500 lb.
Weight on leading truck	26,000 lb.
Weight on trailing truck	54,500 lb.
Weight of engine and tender in working order	572,900 lb.
Wheel base, driving	22 ft. 6 in.
Wheel base, total	41 ft. 3 in.
Wheel base, engine and tender	80 ft. 2¾ in.
Ratios	
Weight on drivers ÷ tractive effort	4.21
Total weight ÷ tractive effort	5.33
Tractive effort × diam. drivers ÷ equivalent heating surface*	710.1
Equivalent heating surface* ÷ grate area	79.5
Firebox heating surface ÷ equivalent heating surface,* per cent	6.13
Weight on drivers ÷ equivalent heating surface*	47.4
Total weight ÷ equivalent heating surface*	60.05
Volume both cylinders	26.18 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	243.6
Grate area ÷ vol. cylinders	3.06
Cylinders	
Kind	Simple
Diameter and stroke	30 in. by 32 in.
Valves	
Kind	Piston
Diameter	14 in.
Greatest travel	6¾ in.
Outside lap	1 1/16 in.
Inside clearance	0 in.
Lead in full gear	3/16 in.
Wheels	
Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	12 in. by 20 in.
Driving journals, others, diameter and length	Front 10 in. by 19 in., others 10 in. by 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.
Trailing truck, journals	9 in. by 14 in.
Boiler	
Style	Conical
Working pressure	185 lb. per sq. in.
Outside diameter of first ring	85½ in.
Firebox, length and width	120 in. by 96¼ in.
Firebox plates, thickness	Crown, back and sides, ⅜ in., tube ⅝ in.
Firebox, water space	Back and sides 5 in., front 5½ in.
Tubes, number and outside diameter	226, 2¼ in.
Flues, number and outside diameter	46, 5½ in.
Tubes and flues, length	21 ft. 3 in.
Heating surface, tubes and flues	4,217 sq. ft.
Heating surface, firebox†	391 sq. ft.
Heating surface, total	4,608 sq. ft.
Superheater heating surface	1,180 sq. ft.
Equivalent heating surface*	6,378 sq. ft.
Grate area	80.2 sq. ft.
Center of boiler above rail	10 ft. 2 in.
Tender	
Tank	Water bottom
Frame	Cast steel
Weight	189,900 ft.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	16 tons

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.
† Includes combustion chamber and arch tube heating surfaces.

A Miniature Motor.—An electric motor of extremely small dimensions has appeared on the market in Germany. The motor is enclosed in a shell of 3 cm. diameter and 4 cm. length and weighs 150g. The shaft is arranged so as to hold tools that are required by dentists and surgeons, but the device should be of great use for other purposes, such as boring small holes in metals and rare stones. The motor can be driven by direct or alternating current, and runs at a maximum speed of 5,000 r.p.m.—*The Engineer, London.*

*See *Railway Mechanical Engineer*, December, 1917, page 673.

Locomotive Feed Water Heating*

Discussion of the Exhaust Steam and Waste Gas Methods of Preheating for Locomotive Boilers

BY H. S. VINCENT

II.

In a feed water heater using waste gases as the heating medium, due to the relatively slow absorption of the heat, it is necessary to greatly increase the heating surface over that required for an exhaust steam heater. This is usually accomplished by applying a large number of tubes of small bore, as by this means the maximum heating surface can be obtained in a given area.

Fig. 9 illustrates in diagrammatic form the heater on which the present study is based. This is composed of 320 tubes, one inch (outside diameter), 6 ft. long, with walls .095 in. thick, giving a total heating surface of 407 sq. ft. These tubes are surrounded by a casing through which the smokebox gases circulate. They are fixed at each end into headers, these headers being divided into ten compartments, in each of which are 32 tubes.

The feed water enters the lower compartment of one header, flowing thence through the 32 tubes to the opposite header, traversing in this way, the heater, ten times before passing into the boiler.

As a basis for determining the transmission of heat from waste gases into the feed water, we will consider the known evaporative capacity of a boiler tube under similar conditions.

When evaporating 54,400 lb. of water per hour, the locomotive under consideration showed a smokebox temperature of approximately 600 deg., and this temperature will be assumed in the present calculations.

From Bulletin 1017, published by the American Locomotive Company, we find that the evaporative value of tubes 2 in. diam. 18 and 19 ft. long, is respectively 79.5 and 81 lb. of water per hour. The difference or 1.5 lb. equals the evaporative value of that portion of the tube one foot long which is subjected to a gas temperature of 600 deg.

With steam at 205 lb. pressure and feed water at 60 deg., the B. t. u. content imparted to the water in the boiler, per second, is:

$$\frac{(1{,}198.5 - 28.08) \times 1.5}{3{,}600} = .488 \text{ B. t. u.}$$

for the total temperature difference; or a heat transmission of:

$$\frac{.488}{600 - 390} = .002325 \text{ B. t. u.}$$

per second per degree of temperature difference.

The heating surface in one foot of 2 in. boiler tube is .523 sq. ft.; therefore the conductance of the boiler tube is;

$$\frac{.002325}{.523} = .00445 \text{ B. t. u.}$$

per second, per sq. ft. of heating surface, for one degree temperature difference.

From tests made by Geo. L. Fowler, on a Jacobs-Schupert boiler when working at capacity, it was found that the average velocity of the flow of water parallel to the longitudinal center of the boiler, was about .65 ft. per second. This record was obtained at a point near the water leg, but we can assume without serious error, the same velocity at a point 18.5 ft. ahead of the back tube sheet.

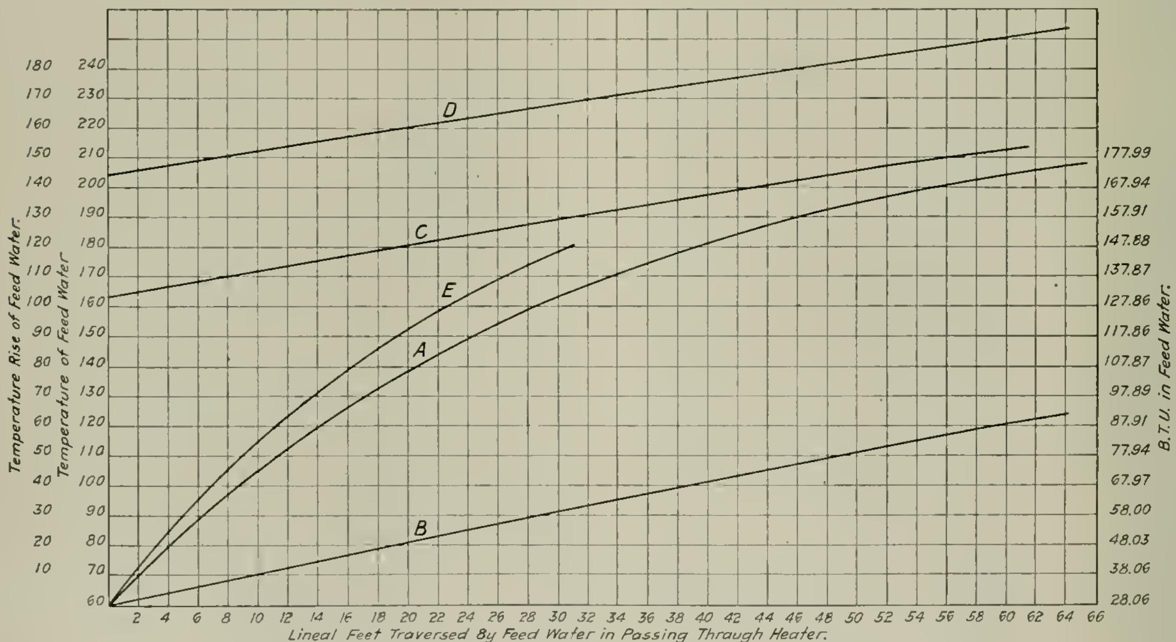


Fig. 6—Rise in Feed Water Temperature Per Lineal Foot of Feed Water Heater Pipes

*The first part of this article, discussing the exhaust steam method of preheating was published in the December *Railway Mechanical Engineer* on page 645.

The weight of water passing through the feed heater is 15.35 lb. per second; the volume per foot of the 32 tubes forming each pass is .1145 cu. ft. and the weight of water per foot entering the heater is 7.14 lb., the velocity in feet per second through each pass is:

$$\frac{15.35}{7.14} = 2.15 \text{ ft.}$$

Referring again to the experiment of Clement and Garland, Fig. 8 gives the relation found between the velocity of the feed water and the conductance of the metal in the tube plus the film on the water side. It is evident that this conductance is independent of the heating medium and that the low heat transmission with gases is due solely to the high resistance of the film on the gas side. The value of this resistance may be determined by the following method.

Reading from the Fig. 8 we find at a water velocity of .65 ft. per second, a conductance through the tube and water film of .1635 B. t. u. per second. The conductance of the boiler tube has been found to be .00445 B. t. u. As the resistance to heat transfer is the reciprocal of the conductance, we have:

$$\frac{1}{\frac{1}{.00445} - \frac{1}{.1635}} = .00458 \text{ B. t. u.}$$

or the conductance of the film on the gas side.

In the Clement and Garland experiment, the thickness of the tube walls was .134 in. with a conductance through the metal of 1.204 B. t. u. With tubes .095 in. thick, the conductance of the metal is:

$$\frac{1}{6.2 \times .095} = 1.697 \text{ B. t. u.}$$

Referring again to Fig. 8, in which the water film is plotted in relation to the velocity of the feed water, we find, for a water velocity of 2.15 ft. per second, a conductance of .227 B. t. u. Combining this with the conductance of the tube, we have:

$$\frac{1}{\frac{1}{1.697} + \frac{1}{.227}} = .200 \text{ B. t. u.}$$

or the total conductance of a tube .095 thick plus the water film. Carrying this further, knowing the conductance of the gas film, we have:

$$\frac{1}{\frac{1}{.200} + \frac{1}{.00458}} = .00448 \text{ B. t. u.}$$

or the conductance of metal, gas and water films.

Having established the conductance we can now determine the quantity of heat transmitted to the feed water by the proposed heater, using equation (5).

Assuming as in the case of the exhaust steam heater that the feed water enters the heater at a temperature of 60 deg., corresponding to a thermal content of 28.08 B. t. u. and with the average temperature of the heating gases 600 deg., the heat absorbed per lb. of feed water during its traverse through the first pass, or the first six lineal feet, is given by the following equation:

$$Q = \frac{k^{\circ} A\, hm\, L}{s\, w'} \quad \ldots\ldots (8)$$

s = Velocity of water in feet per second.
w' = Weight of water in L ft. of the heater.
L = Number of lineal feet through which the heat transfer is in progress.

Using the quantities as determined above:

$$Q = \frac{.00448 \times 40.7 \times (600 - 63) \times 6}{2.15 \times 42.84} = 6.37 \text{ B. t. u.}$$

Or at the end of the first pass the heat content of the feed water is 28.08 + 6.37 = 34.45 B. t. u. corresponding to a temperature of 6.64 deg.

By a similar step by step process it will be found that at the end of the tenth pass or 60 lineal feet, the thermal content of the feed water has risen to 88.76 B.t.u. corresponding to a temperature of 120.7 deg.

This increase in temperature and thermal value is shown graphically by curve *B* in Fig 6. It will be observed that

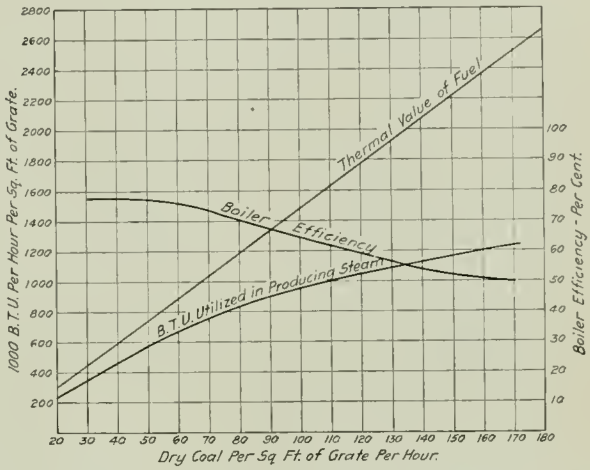


Fig. 7—Efficiency Curves of a Locomotive Boiler Without a Feed Water Heater

this curve is practically a straight line, indicating that in this type of heater the temperature rise is nearly proportional to the heating surface traversed by the feed water.

In the above calculations it has been assumed that the velocity of the gases through the heater will be equal to that through the boiler tubes.

The direct economy obtainable is given by equation (7).

Applying this equation, we find for a heater of the type

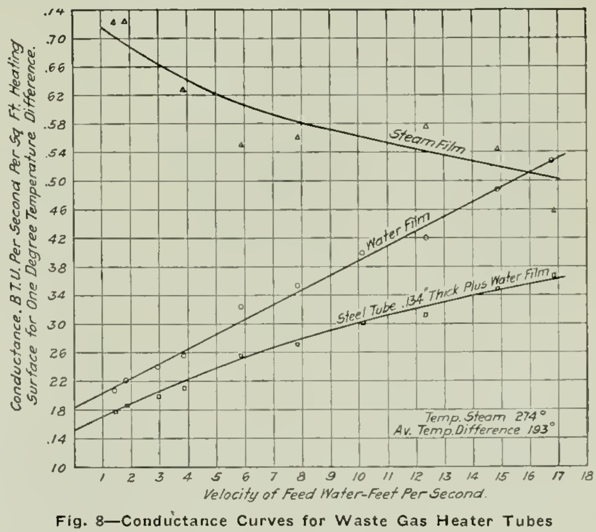


Fig. 8—Conductance Curves for Waste Gas Heater Tubes

and proportions illustrated by Fig. 9, a direct economy of:

$$100 \frac{1{,}170.42 - (60.68 - 20.48)}{1{,}170.42} = 3.4 \text{ per cent.}$$

In these calculations it has been assumed that a feed pump will be used for forcing the water through the heater, using 1.75 per cent of the total amount of steam generated.

The direct economy which is obtained by feed water heating with waste gases reduces the unit fuel consumption to:

$$\frac{120 \times 1{,}130.2}{1{,}170.42} = 116 \text{ lb.}$$

Referring to Fig. 7, it will be seen that the ordinate for a unit fuel consumption of 116 lb. crosses the boiler efficiency curve at 60 per cent, as the efficiency when burning 120 lb. is 59 per cent, the indirect economy equals 1 per cent, or a total economy for the waste gas heater of 4.4 per cent.

The relatively great difference in the temperature of the exhaust steam and the smokebox gases makes possible a further economy through arranging the heaters in series with the exhaust steam as the primary and the waste gases as the secondary heating medium. We have seen that the temperature of the feed water issuing from the exhaust heater having 30 lineal feet traverse, is 163.3 deg., with a total thermal content of 131.16 B.t.u. If this water on passing from the exhaust heater is made to traverse the waste gas heater, it will attain a final temperature of 213.65 deg. with a thermal content of 181.65 B.t.u.

This increase in temperature is shown by curve *C* on Fig. 6; it will be observed that with the decreased temperature head between the waste gases and the feed water, the curve still approximates a straight line.

The direct economy by series heating is:

$$100 - \frac{1{,}170.42 - (153.57 - 20.48)}{1{,}170.42} = 11.5 \text{ per cent.}$$

and the fuel consumption is reduced to:

$$\frac{120 \times 1{,}037.33}{1{,}170.42} = 106.5 \text{ lb.}$$

From diagram Fig. 7 the ordinate for a unit fuel consumption of 106.5 lb. crosses the curve at an efficiency of 62.7 per cent, or an indirect saving of 3.4 per cent; this, added to the direct economy, equals 15.2 per cent.

By placing the waste gas heater in series with the exhaust heater having a traverse of 60 lineal feet, the temperature of the feed water would be increased to 250.25 deg., and the thermal content to 218.76 B.t.u. The direct economy would be:

$$100 - \frac{1{,}170.42 - (190.68 - 20.48)}{1{,}170.42} = 14.5 \text{ per cent.}$$

The unit fuel consumption would be reduced to:

$$\frac{120 \times 1{,}000.22}{1{,}170.42} = 102.3 \text{ lb.}$$

From Fig. 7 the ordinate for 102.3 lb. crosses the efficiency curve at 64 per cent, therefore the indirect economy is 5 per cent, and the total economy 19.5 per cent.

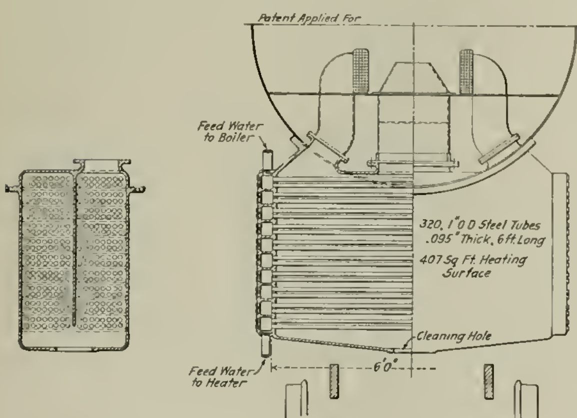


Fig. 9—A Type of Waste Gas Feed Water Heater

The constant steam consumption of 1.75 per cent, which has been assumed for the feed pump, may be increased when forcing the water through the two heaters in series, in which case the figured economy will be slightly decreased.

Table II presents a summary of the results obtained in this study of the various types of heaters, as compared with a locomotive not so equipped, but fitted with the ordinary injector. It will be observed that with the injector the water enters the boiler at practically the same temperature as from the exhaust steam heater having 30 lineal feet traverse, there is, however, with the injector no economic gain, as the heat given up by the steam is equal to the heat given to the feed water plus the external work done; this amounts to a loss in the present instance of approximately .7 per cent. In this table is shown the area of exhaust nozzle required with the various rates of combustion, to produce the necessary draft.

Table II

	Without heater	Exhaust steam heater 30 lin. ft.	Exhaust steam heater 60 lin. ft.	Waste gas heater 60 lin. ft.	Series heaters. Waste gas and exhaust steam 30 lin. ft.	Series heaters. Waste gas and exhaust steam 60 lin. ft.
Boiler pressure	205	205	205	205	205	205
Total heating surface in feed heater	...	71.2	142.4	407	478.2	549.4
Unit fuel consum. per hour	120	111.5	107.5	116	106.5	102.3
Av. temp, heating medium	...	230	230	600	230-600	230-600
Temp. feed water entering heater	...	60	60	60	60	60
Temp. feed water entering boiler	injector 163.9	163.3	204.3	120.7	213.65	250.25
Thermal content feed water entering heater	...	28.08	28.08	28.08	28.08	28.08
Thermal content feed water entering boiler	131.7	131.16	172.27	88.76	181.65	218.76
Thermal units gained by heating	...	82.60	123.71	40.20	133.09	170.2
Direct economy by heating	...	7.2	10.7	3.4	11.5	14.5
Indirect economy by heating	...	2.6	3.5	1.0	3.7	5.0
Total economy by heating	...	9.8	14.2	4.4	15.2	19.5
Area exhaust nozzle required	38.19	30.2	30.8	30	30.9	31.3
Diameter of exhaust nozzle required	6.97	6.2	6.26	6.18	6.27	6.32

The thermal balance sheet for the exhaust steam heater, having 60 lineal feet traverse, in series with the waste gas heater, is shown in Table III. This gives the percentage of total heat supplied by the boiler and the two heaters, also as divided between the engine and the feed pump, during one hour's operation. Instead of the boiler having to supply 63,669,760 B.t.u., as in the injector fed engine, fuel has only to be burned to supply 54,285,365 B.t.u., or a reduction in unit fuel consumption from 120 lb. to 102.3 lb. per sq. ft. of grate per hour.

Table III

Source of heat	Proportion of total heat supplied	Percentage of total heat supplied	B. t. u. supplied To engine	B. t. u. supplied To pump	B. t. u. supplied To engine and pump
Exhaust steam heater	144.19 / 1,170.42	12.31	7,837,747	142,779	7,980,526
Waste gas heater	46.49 / 1,170.42	3.97	2,517,689	46,046	2,563,735
Boiler	979.74 / 1,170.42	83.72	53,314,324	971,041	54,285,365
		100.00	63,669,760	1,159,866	64,829,626

CONCLUSIONS

Exhaust steam is superior to waste gases as a heating medium due to the low resistance of the steam film to the transmission of heat.

In a heater using exhaust steam the use of copper tubes is to be preferred to steel or iron on account of their higher conductance. Tubes should have walls as thin as is consistent with strength and wearing qualities.

Exhaust steam may be diverted for heating the feed water without detriment to the operation of the locomotive if the area of the exhaust nozzle is decreased to give the required draft. This can be done without any increase in back pressure on the pistons.

An exhaust steam heater such as is shown by Fig. 7, if fitted with copper tubes, will give an economy in fuel of about 11.8 per cent when using 13 per cent of the exhaust steam.

The economy of the heater using waste gases as a heating medium increases nearly in direct proportion to the heating surface. It is very difficult, however, to find space on a locomotive for a heater giving over 5 per cent economy.

High economy may be obtained by using exhaust steam and waste gases in series, but there is not sufficient room on a modern locomotive for such an application.

It is very desirable that further investigation be made of the heat transmitting property of the gas film.

TABLES FOR COMPUTING THE AREA FOR BOILER LAGGING

BY WILLIAM N. ALLMAN

For the purpose of determining the area in square feet required in lagging for boilers, cylinders or other heated surfaces to be insulated, the tables shown will be found convenient. As it is the general practice of the various lagging manufacturers to furnish lagging in six-inch widths, the tables are computed on this basis. In establishing the area required it will be understood there are perfectly flat surfaces, and also curved surfaces to deal with, and naturally, cylindrical or curved surfaces require lagging with curved faces. The thickness of the lagging for the cylindrical sheets is the basis for making the computations and the maximum thickness should always be used. By maximum thickness is meant the thickest end where a tapered sheet is used; for example, a block six inches wide by 36 in. long may be 1½ in. thick on one end, two inches on the other, in which case two-inch thickness is the one to consider.

Table I

Thickness of lagging	Concave Chord	Convex Chord
¾ in. to 15/16 in.	6 in.	6 3/16 in.
1 in.	6 in.	6¼ in.
1 1/16 in. to 1 7/16 in.	6 in.	6 5/16 in.
1½ in. to 1 15/16 in.	6 in.	6⅜ in.
2 in.	6 in.	6 7/16 in.
Over 2 in.	6 in.	6½ in.

Table II—Areas, in Square Feet, for Convex Blocks of Various Radii

Length in inches	6 3/16 in. wide. Area, sq. ft.	6¼ in. wide. Area, sq. ft.	6 5/16 in. wide. Area, sq. ft.	6⅜ in. wide. Area, sq. ft.	6 7/16 in. wide. Area, sq. ft.	6½ in. wide. Area, sq. ft.
1/64	.00067	.00067	.00068	.00069	.00698	.00070
1/32	.00134	.00135	.00136	.00138	.00139	.00141
1/16	.00269	.00271	.00273	.00276	.00279	.00282
⅛	.00537	.00542	.00547	.00553	.00558	.00564
¼	.01074	.01085	.01095	.01106	.01117	.01128
½	.02148	.02170	.02191	.02213	.02235	.02256
¾	.03223	.03255	.03287	.03320	.03352	.03385
1	.04297	.04340	.04383	.04427	.04470	.04513
2	.08593	.08680	.08767	.08541	.08940	.09027
3	.12890	.13020	.13151	.13281	.13411	.13541
4	.17187	.17361	.17534	.17708	.17881	.18055
5	.21484	.21701	.21918	.22135	.22352	.22569
6	.25781	.26041	.26302	.26562	.26822	.27083
7	.30078	.30381	.30685	.30989	.31293	.31597
8	.34375	.34722	.35069	.35416	.35763	.36111
9	.38671	.39062	.39453	.39843	.40234	.40625
10	.42968	.43402	.43836	.44270	.44704	.45138
20	.85937	.86805	.87673	.88541	.89409	.90277
30	1.28906	1.30208	1.31510	1.32812	1.34114	1.35416
40	1.71875	1.73611	1.75347	1.77083	1.78819	1.80555
50	2.14843	2.17013	2.19184	2.21354	2.23524	2.25694
60	2.57812	2.60416	2.63020	2.65625	2.68229	2.70833
70	3 00781	3.03819	3.06857	3.09895	3.12934	3.15972
80	3.43750	3.47222	3.50694	3.54166	3.57638	3.61111
90	3.86718	3.90624	3.94531	3.98437	4.02343	4.0625

In using Tables II and III it is necessary to refer to the key contained in Table I.

It is to be understood that in considering the area of a certain size block for a given radius that the ruling factor is the thickness, regardless of the radius of the particular boiler sheet. Considering the block mentioned above, namely, 36 in. by 6 in. by 2 in., we find in Table I that the convex chord for this thickness is 6 7/16 in. Referring to Table II (6 7/16-in. wide), we find that the area for a block 30 in. long is 1.34114, for a 6-in. block .26822, giving an area of 1.60936 sq. ft. for the entire block. Had the length been 36½ in., the area for a block ½ in. long (.02235) should be added, giving a total area of 1.63171 sq. ft. Should the length be equal to a figure not shown outright in the table, such as 36⅞ in., all that is necessary to do is to take the value of 30 in., 6 in., ¾ in. and ⅛ in. and add them together.

Table III—Areas, in Square Feet, for Straight Blocks, 6 In. Wide

Length in inches	Area in square feet	Length in inches	Area in square feet	Length in inches	Area in square feet
1/64	.00065	3	.1241	30	1.2501
1/32	.0013	4	.16667	40	1.6668
1/16	.0026	5	.20835	50	2.0835
⅛	.00521	6	.25	60	2.5003
¼	.01042	7	.29169	70	2.9169
½	.02083	8	.33336	80	3.3336
¾	.03125	9	.37503	90	3.7503
1	.04167	10	.4167		
2	.08333	20	.83334		

When figuring on lagging for domes and cylinders, which generally runs in one-half the width of the regular boiler lagging, or three inches wide, use just one-half the values shown in the tables.

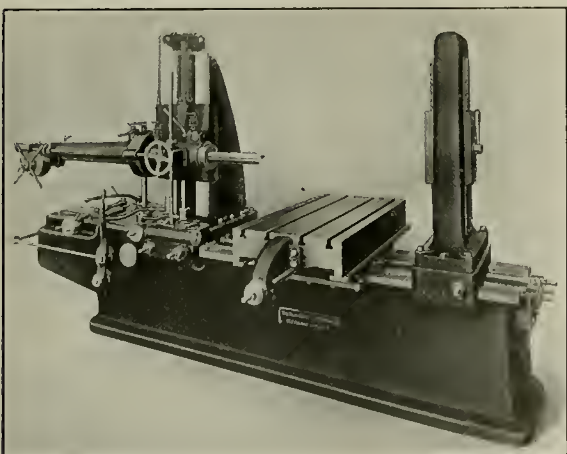
In considering the areas for flat sheets use Table III. In the case of flat sheets, the thickness of the lagging does not enter into the calculations, as the area is the same, regardless of whether it is one-inch thick or two inches thick.

The Need of Locomotives in China.—One of the pressing needs of China today is locomotives. The demands upon the railways have far exceeded the expectations of the builders. The locomotives bought in the first instance have proved too small, and it is now clearly realized by the technical advisers of China that they must standardize upon a type that will meet their needs for a long time to come. This question is being earnestly considered at the present time. Of the fifteen lines composing the system of Chinese Government railways, only one was built by the Chinese themselves; it is financed by the Chinese Government, and is operated exclusively by Chinese. The funds for the construction and equipment of the various other railway lines of China were furnished by foreign capital of various nationalities, but, according to the American authority, Charles Denby, special assistant to the department of state, not in a single instance has America so constructed and equipped any of these lines. As a result, today the Continental—European—design of locomotive is predominant in China. On some of the lines, notably those under English and, hitherto, German influence, not a locomotive other than those built in accordance with the prevailing design common to the nation financing the railway was purchased or even considered, either for initial or subsequent equipment—at least up to the time of the outbreak of the war. Only in the case of the Chinese financed and operated railway have American builders been given a free hand, with the result that an American design was adopted, and a thorough standardization of power effected. Out of the 638 locomotives in service on all lines at that time only 15½ per cent were of American design and manufacture; and on the English, Belgian, and French lines, which operated at that time 365 locomotives, or approximately 60 per cent of the total, only eight, or approximately 2.2 per cent were of American design and manufacture.—*Eastern Engineering.*

NEW DEVICES

THE BLOMQUIST-ECK HORIZONTAL BORING MILL

The working efficiency of any horizontal mill and drill depends entirely upon its ability to operate upon all classes of work at the highest speeds and coarsest feeds practicable, and at all times to produce a finished product of dependable accuracy. The Blomquist-Eck Machine Company, Cleveland, Ohio, in designing its new horizontal boring mill, has developed these points to a high degree by combining rigidity, accuracy, a suitable range of selective speeds and feeds with a high standard of material and workmanship. The various groups of mechanism form complete individual units and any unit can be inspected, removed or replaced without disturbing the alignment or any adjoining unit. The bed or base is of an unusually wide and deep box section, being cast entirely in one piece. The outer walls directly under the column are left intact, without cored openings, which adds greatly in resisting the lines of stress. Chip chutes are provided and so arranged that their walls give added strength. The bed (directly under the column) is reinforced by sections tied together and cast integral with the base. The bed is further reinforced by heavy deep ribs running lengthwise, and at right angles the three-point support or bearing is also incorporated in the construction.

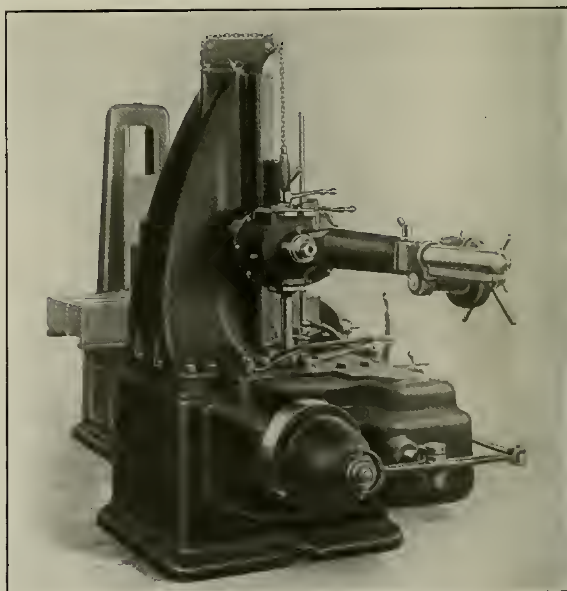


Blomquist-Eck Horizontal Boring Mill

The column is of a rigid box section, strongly braced internally by ribs in both horizontal and vertical positions. The base of the column has a liberal bearing upon the bed, eliminating deflections and spring.

The spindle saddle is designed with a liberal bearing surface on the face of the column, a long narrow guiding edge with single screw adjustable taper gib for adjustments on one side and square lock form with gib on the other side. The center of the spindle in the spindle saddle is placed as close to the column face (reducing overhang to a minimum) without sacrificing strength at a point most desired. The elevating screw which is between the column faces and the spindle, is so placed in relation to the narrow guide that the vertical movement of the saddle is direct and accurate. The units comprising the spindle and saddle are counterbalanced by a weight within the column.

The spindle is made from carefully selected high carbon steel, heat-treated, and is ground for its entire length. It is bored for a No. 5 Morse taper and is provided with an end thrust for operating in either direction. The spindle sleeve consists of a special hammered high carbon steel forging accurately ground inside and out. The front and rear spindle sleeve bearings are adjustable and tapered, being made of genuine government bronze. Either bearing can be adjusted to compensate for wear. Sight feed oil cups provide an adequate lubrication.



End View of Blomquist-Eck Horizontal Boring Mill

The boring bar support is raised or lowered in unison with the spindle saddle by a shaft and a set of planed steel bevel gears. The bar support or bearing proper is securely clamped by a lever binding bolt at any position..

The Method of Driving.—The close-coupled drive gear shafts, mounted on S. K. F. double-row, self-aligning ball bearings, transmit the power to the spindle in a direct and practical manner. All shafts are made of high carbon steel. Hardened steel ring spur gears, heat treated, are used wherever possible, and these are shrunk onto cast-iron hubs. The smaller spur gears in the drive are made of solid steel and heat treated. The bevel gears are made of hammered steel forgings planed from the solid. The speed changes are made by two levers at the front of the machine which operate the selective sliding gears. The entire driving mechanism is well located on the base and each individual shaft and bearing can be removed or replaced without disturbing any adjoining unit. Access to the entire unit may be had through an oil-tight top-plate cover, the removal of which permits an easy inspection when required. All gears run in a bath of oil, and in addition a positive cascade oiling system is provided for both gears and bearings.

The feed to the spindle in either direction, to the spindle saddle in raising or lowering upon the column, to the table saddle paralleling the bed, or to the table longitudinally upon its saddle, is introduced in the same direct positive geared manner as applied to the spindle drive. Shafts are made of high carbon steel mounted on S.K.F. ball bearings. The gears are of steel and heat treated. The feed mechanism in the base is arranged so any unit may be removed or replaced without disturbing any adjoining unit. All gears run in a bath of oil, and in addition a positive cascade oiling system is provided for bearings and shafts. The feed changes are made by two levers which are placed directly in front and at the top of the gear box. In addition there are three selective interlocking levers provided that engage either the spindle, vertical or table feeds. No two conflicting feeds can be engaged at the same time. In operating star feed facing heads or work of similar nature all feed levers can be positively locked in a neutral position.

Following are the principal dimensions of the machine:

Table and Saddle—The bed surfaces are designed and proportioned to compensate for any overhang of the table at the extreme front or rear positions. When the table is in either extreme position it is supported in the saddle practically three-fourths of its entire length. The saddle is gibbed to the bed by the square lock method having a long, narrow guiding edge with a taper gib for adjustment. The table is of an extra heavy pattern, long, wide and deep, being reinforced by heavy ribs. The table is securely gibbed by the square lock method, which in this instance resists any strains when the table is in an overhanging position.

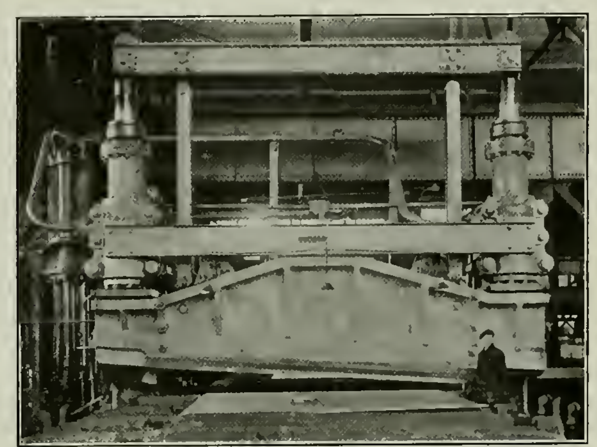
Power rapid traverse of a friction type is provided for all members operated by the feed. Regardless of whatever feed may be engaged, the rapid traverse always operates at one rate of speed in either direction. An adjustable safety friction leather washer in the clutch mechanism prohibits damaging any portion of the mechanism engaged. The clutch control is sensitive, and practically any amount of travel can be had. Hand adjustments to the spindle saddle, spindle travel, table saddle or table are provided in addition to the automatic feeds. All screws are fitted with graduated dials reading in thousandths of an inch.

Single friction clutch pulley drive operating at constant speed is regularly furnished. Constant speed or adjustable speed motor drive can be furnished. Any type of electrical control can be provided.

Diameter of spindle	3¼ in.
Travel of spindle	30 in.
Number of spindle speed changes	12
Range of spindle speeds in r.p.m.	16 to 196
Number of feed changes to spindle or table	9
Number of feed changes to spindle or table with back gears	18
Ranges of feed in inches per each revolution of spindle	.003 in. to .518 in.
Working surface of table	24 in. by 54 in.
Automatic longitudinal feed to table	36 in.
Automatic transverse feed or parallel movement of table with bed	37 in.
Maximum distance spindle nose to outboard bearing	5 ft. 5 in.
Maximum distance top of plain working table to center of spindle	27 in.
Diameter constant speed friction drive pulley	14 in.
Width of driving belt	4 in.
Weight crated domestic shipment (standard length) Approx.	11,600 lb.
Size of motor recommended	5 hp.

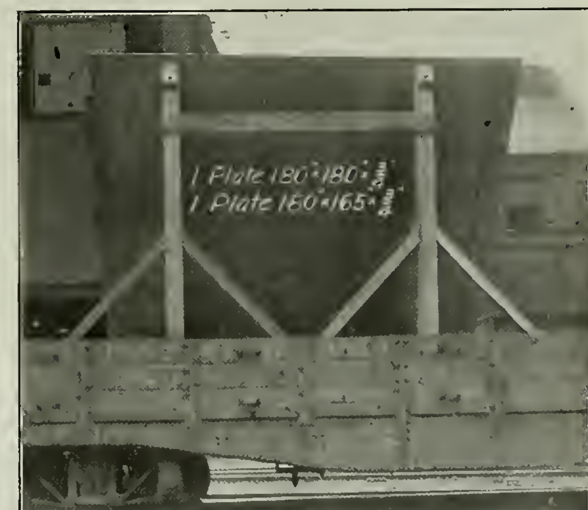
THE LARGEST PLATE MILL IN THE WORLD

The Lukens Steel Company, Coatesville, Pa., has for the fourth time in its history the largest plate mill in the United States. This company, at whose plant the first boiler plate in America was made in about 1820, had in 1890 a 120-in. plate mill, which was later rebuilt to the 134-in. size; in 1903 a 140-in. unit was placed in service, and now with its 204-in. No. 5 mill it has for the fourth time the largest



Hydraulic Shears 210 in. Between Housings, Having Capacity for 2-in. Plate

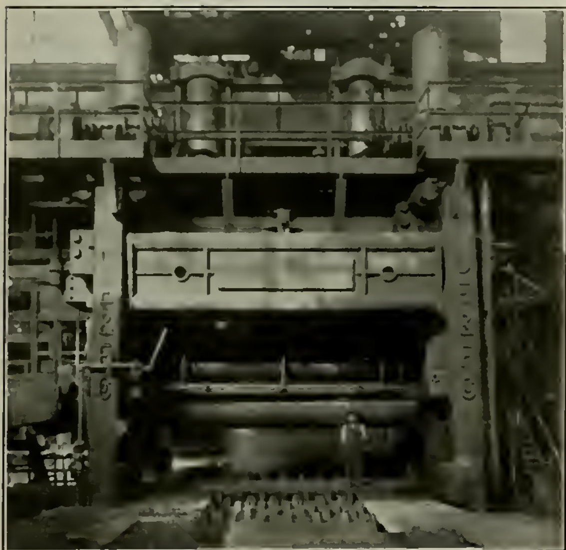
mill in the United States. This mill also exceeds anything in any other country, exceeding the 178-in. mill of the Witkowitz Works in Austria and the 168-in. mill in the British Isles. This new mill is capable of rolling plates up to 192-in. in width and circular pieces a few inches wider, with comparatively little variation in the gage at the center of the



Two Plates of Locomotive Firebox Steel Ready for Shipment to the Pennsylvania Railroad

plate. A novel device for handling and weighing the plates after shearing, designed by C. L. Huston, vice-president and mechanical engineer of the Lukens Steel Company, has been installed, and further devices are being planned to eliminate almost entirely all hand labor about the shearing department and to more accurately cut the plates than has been possible by methods heretofore in general use. Facilities have also been provided for flanging heads in one piece. For 15-ft. boilers the entire head is heated and flanged at one time, the work being done by the rolling process, which provides a better head than when heads of such diameter are made in two pieces.

When the construction of this large mill was contemplated attempts were made to build a 180-in. three-high mill after the accepted American practice. When it came to obtaining the chilled rolls of the size and weight desired, however, there was no manufacturer to be found in this country who could be persuaded to undertake the contract. Such a mill required chilled rolls of 50 in. in diameter, which was larger than anything the rollmakers had ever attempted. To overcome



The New No. 5 Mill for 192-in. Plates, Lukens Steel Company

this difficulty Mr. Huston proposed the adoption of the four-high reversing type of mill, the design of which was carried out in collaboration with the engineering staff of the United Engineering & Foundry Company. This new mill is built on the principle of the two-high reversing plate stand commonly used in the British Isles, being modified by having two large supporting rolls to back up the two finishing rolls in order to stiffen the mill and give it added strength to prevent the operating rolls from springing when wider than plates are being handled. This arrangement enables the use of operating rolls of smaller diameter and thereby overcomes the difficulty of obtaining the large chilled rolls. These operating rolls are 34 in. in diameter and have a working face of 204 in. with 27-in. necks. They weigh about 30 tons each. The 50-in. diameter backing rolls are made of cast steel, with 36-in. necks and weigh about 60 tons each.

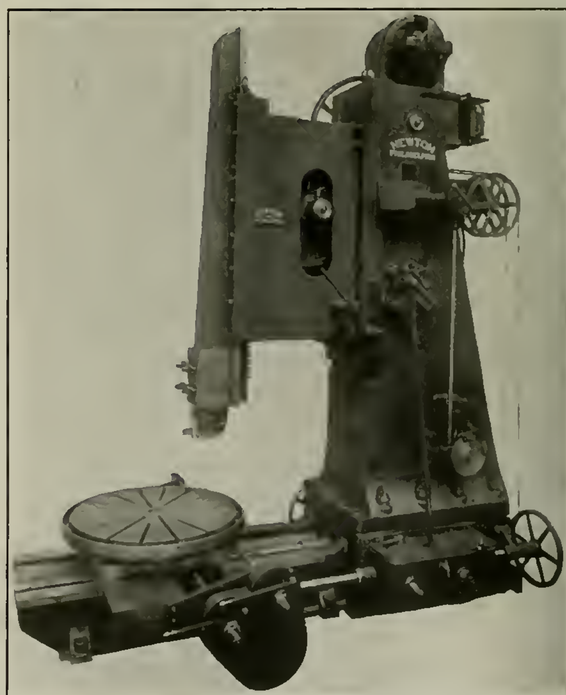
It was necessary to use a housing of a built-up type, as it is so large that the machining and transportation of such a housing cast in one piece would be impossible. Each housing weighs 400,000 lb. The mill stands about 40 ft. from the top of the screw cover to the bottom of the shoes, and is slightly over 42 ft. in height over all. The foundation of the mill is of concrete built on solid rock. The screw-down rig is driven by 150-hp. motors, one on each housing. The mill pinions are of cast steel, having a 42-in. pitch diameter and a 60-in. face. These pinions are connected to the working rolls by spindles 20 ft. long. Special provision was made for removing the smaller chilled rolls for grinding, which is done in a special grinding machine built by the Norton Company, the largest grinder ever built for this class of work.

The mill is driven by a 46-in. and 70-in. by 60-in. twin tandem compound condensing engine fitted with a jack-shaft and gear ratio of one to two. This engine was designed and constructed by the Mesta Machine Company. The plates after being rolled pass over the turnout table, 65 ft. long, to the straightening rolls, which were furnished by the Hilles and Jones Company after Mr. Huston's design. An inspection tilt-up device for raising the plates so that the bottom side may be inspected is provided, being operated by hydraulic cylinders. After inspections the plates are conveyed to the cut-off shear, which is hydraulically operated and which is 210 in. between housings.

The mill will handle ingots up to 60,000 lb. in weight. When it is operated to full capacity it is estimated that it will roll from 4,000 to 5,000 tons per week. To supply the increased metal to operate this new mill an addition to the steel plate mill of six basic open-hearth furnaces of 100 tons capacity each, has just been finished. With the other furnaces in operation and an additional two more which are contemplated, the Lukens Steel Company will have an estimated annual capacity of about 500,000 tons of finished plate. This company furnishes the majority of railroad locomotive boiler steel used in this country.

UPRIGHT GENERATING PLANERS

The Newton Machine Tool works, Inc., Philadelphia, Pa., having found that the term "slotting machine" does not suggest the possibilities of its equipment formerly known under that name, has called its latest design, which has recently been placed on the market, "upright generating planer." This machine, which is shown in the illustrations, has a stroke of 72 in., other sizes being built down to 36-in. maximum stroke. These machines are rack driven and are provided with a newly developed method of stroke control



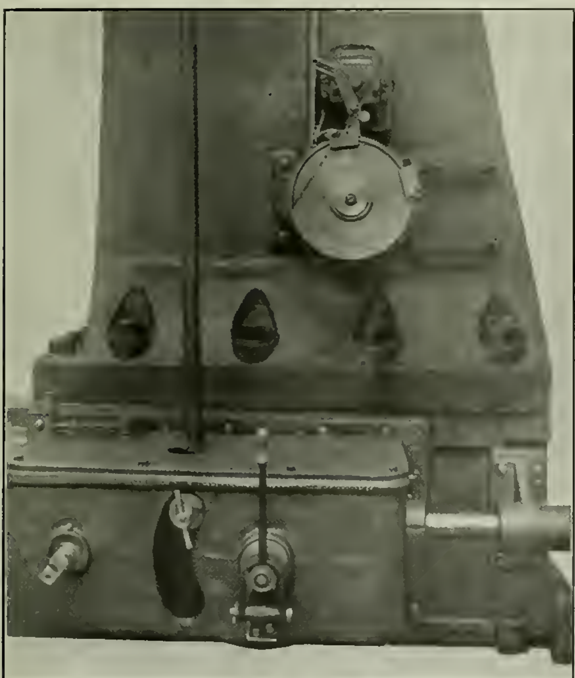
Newton Upright Generating Planer

disk, a close-up view of which is included with this article. The trips on this control disk can be operated by hand while the machines are in motion, which is desirable as the drift of the motor has to be compensated for.

This machine represents an entirely new development. It is rigid, conveniently controlled and is designed to insure permanency of alignment. The rams or cutter bars are counterweighted, having square bearings in the guides with taper side adjusting shoe and, on all sizes, the vertical clamping surface is solid and steel faced and equipped with suitable tool holding clamps. Beneath the ram or cutter bar is mounted a newly developed steel swiveling relief tool box apron, which can operate in any position of a complete circle.

The motion is transmitted from the motor to the broad face steel rack on back of the cutter-bar or ram through all steel spur reduction gears, whose coarseness of pitch and width of face increase with reduction of the gear speed. All gears are covered and on the operating side of machines, all gears are totally enclosed. The circular tables are heavily ribbed and of substantial construction and have full bearing on the saddle to which they are held by corner clamps. These tables are centered by a deep face, large diameter bearing. The oil pans are cast solid with circular tables and are graduated on the exterior into 360 degrees. The table saddles have narrow guide alignment control with centralized location of feed screw and taper shoe control of fit. Hand adjustment of the saddle is provided for from both ends of the cross slide.

All feed motions are independently clutched and the clutches have independent levers. The cross slide is of



Stroke Control Disc for Newton Upright Generating Planer

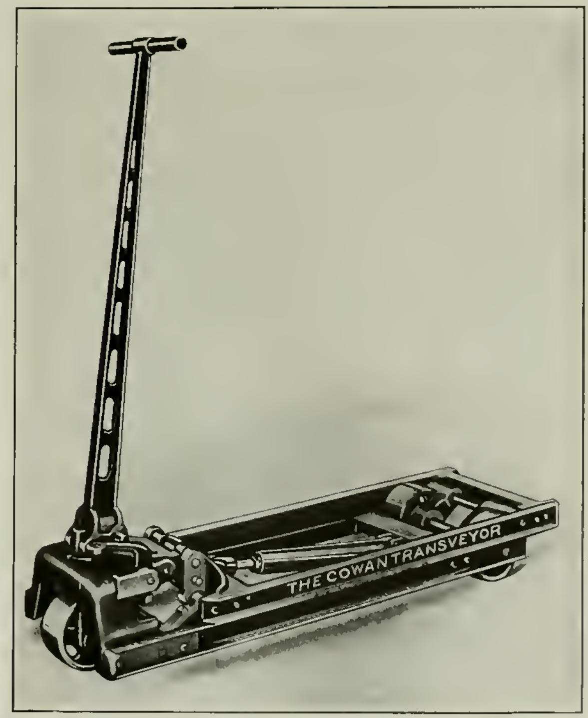
heavy box type section and has square bearings on the base with side adjustment taper shoe. Adjustment is from operating side, as well as from front of machine. The feed screws have bearings on each end to insure operation in tension. The feed motion is taken from a rocking friction box on the outside of which the pawl rod stroke adjusting screw is located. The circular, cross and longitudinal feeds are variable in rate and reversible through the use of pawl and ratchet wheel.

The cutter bar guide on the 36-inch stroke machine is cast solid with frame, and, therefore, does not have any vertical adjustment, while on the 56-inch to 72-inch machines inclusive, they are separate from the frame and have vertical hand-controlled adjustment to permit their being located in positions relative to cutter bars. The cutter bar guide adjusting mechanism is of tandem design to prevent dropping of guide in event of accidental breakage of counterweight ropes.

These upright generating planers are now built for reversing planer type motor drive only. The motor speed should be between 400 and 1,200 R. P. M. and the ratio should preferably be 3 to 1. Rapid traverse for table motions, can be provided as an extra, when desired, through incorporation of suitable mechanism and use of extra constant speed motor.

NEW TYPE OF TRANSVEYOR

The latest addition to the line of transveyors manufactured by the Cowan Truck Company, Holyoke, Mass., is its new Model G. This transveyor is of rugged construction and is an easy elevating machine. The leverage is



Cowan Type G Transveyor

such that the maximum load can be readily elevated by one man. It is made in several sizes varying in capacity from 1,000 to 3,000 lb. It is fitted with an improved locking device. This was chiefly designed to safeguard against the load becoming unseated when trucking over uneven floors. Various other improvements are incorporated in this new machine. The ease with which this transveyor elevates its maximum load, and its quick operation makes it particularly applicable to plants whose trucking requirements demand trucks of the above mentioned capacities.

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 7,400 copies were printed; that of these 7,400 copies 6,348 were mailed to regular paid subscribers, 57 were provided for counter and news company sales, 186 were mailed to advertisers, 66 were mailed to employes and correspondents, and 743 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 7,400, an average of 7,400 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.)

Employees of the Pennsylvania Railroad furloughed for military service, up to November 1, numbered 24,712, and it is announced that every one of these who returns honorably discharged can have his former position or another equally good.

Government regulation of steel prices was discontinued on December 31, following a meeting of the committee of the American Iron and Steel Institute with the War Industries Board in Washington on December 11. The steel producers have proposed a voluntary reduction in steel prices.

S. M. Felton, who as director general of military railways has had charge of the organization and despatch abroad of all railway forces and the purchase of all railway material for the American Expeditionary Forces, resigned on December 31, and will return to his railroad work at Chicago as president of the Chicago Great Western.

The Fuel Administration has in preparation a compilation of all rules and regulations promulgated during the life of the administration. This will be brought down to date January 1, 1919, and will be issued as soon thereafter as possible. It will be a bound volume of perhaps 500 pages. All persons desirous of obtaining a copy of this should communicate at once with the Bureau of Education, Washington, D. C.

The Professional Division of the United States Department of Labor, office at 16 East 42d street, New York City, invites employers of all classes who want university graduates in mechanical, electrical and civil engineering, and in chemistry, to make use of the facilities of that office in securing men who are retiring from the army or the navy. J. O. Winslow, special agent, in charge of the office, is making a list of engineers and other technically qualified men who are retiring from the military service and desires to have the names of all men of this class seeking employment. The record of each man is carefully investigated before registration.

The Engineering Index, published for 25 years in The Engineering Magazine and its successor, Industrial Management, an index to engineering periodical literature, has been acquired by the American Society of Mechanical Engineers, and hereafter will be compiled and published by this society. The first issue of the Index under its new management appears in the January number of The Journal. As heretofore, The Engineering Index will be regularly issued in three different forms: (1) As a part of The Journal of the Society; (2) as a separate monthly publication for libraries or individuals desiring to clip the items for indexing purposes, and (3) as an annual volume in which all the items for the year are collected.

MEETINGS AND CONVENTIONS

Railway Storekeepers' Association.—The fourteenth annual business meeting of the Railway Storekeepers' Association will be held at the Hotel Sherman, Chicago, on January 27, 28 and 29, 1919. The following subjects will be discussed at this meeting:

Fundamental principles of railway storekeeping, H. C. Pearce.
Unapplied material, committee report, W. D. Stokes.
Labor and labor saving devices, J. R. Mulroy.
Scrap and scrap handling, W. F. Jones.
The use, inspection and handling of lumber and cross-ties, M. E. Towner.
Conservation of material, J. G. Stuart.
Conservation of Cars, H. E. Ray.
Accounting for materials in the stores department, J. H. Waterman, H. E. Ray and U. K. Hall.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Jan. 14	The Preservation of Ties	H. K. Wicksteed	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Jan. 10	Fuel Conservation. Election of Officers	V. C. Randolph	Harry D. Vought	95 Liberty St., New York.
Cincinnati	Feb. 11	....	....	H. Boutet	101 Carew Bldg., Cincinnati, Ohio.
New England	Jan. 14	Acetylene Welding	W. L. Bean	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Jan. 17	Organization and Work of the Engineering and Maintenance Department of the Division of Operation	C. A. Morse	Harry D. Vought	95 Liberty St., New York.
Pittsburgh	Jan. 23	U. S. Naval Batteries in France, illustrated by lantern slides. Luncheon following business session	Lt. Com. D. C. Buell	J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	Jan. 10	....	....	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Jan. 20	An Efficient Use of Power Plants	Edmund Burke	A. F. Stuebing	750 Transportation Bldg., Chicago.

Air Brake Association.—At a meeting of the executive committee of the Air Brake Association, held on December 5, in Pittsburgh, Pa., it was arranged to hold the 26th annual convention in Chicago on May 6, 7 and 8, 1919. The subjects adopted by the committee for discussion are as follows:

"Air Requirements for Pneumatically Operated Devices for Locomotives," C. H. Weaver, chairman.
"Cleaning, Repairing, Lubricating and Testing Freight Car Brake Cylinders," by Mark Purcell.
"Reclamation and Conservation of Material," T. L. Burton, chairman.
"Twenty Per Cent Overload Allowed on Heavy Grade Braking," by C. H. Rawlings.
"Holding Standing Trains and Cars on Grades," by R. J. Watters.
"Recommended Practice Report," H. A. Clark, chairman.
"M. C. B. Air Brake Defect Card."
"How Can Enginemen and Trainmen assist in Air Brake Maintenance," by H. A. Glick.

It was decided to invite car and locomotive builders each to send a representative to the convention for their information as to the best methods of installing air brake equipment.

June Mechanical Conventions.—At the meeting of the executive committees of the American Railway Master Mechanics' Association, the Railway Master Car Builders' Association, and the Railway Supply Manufacturers' Association at the Hotel Biltmore, New York, on December 20, arrangements were made for the holding of a mechanical convention at Atlantic City in June. Inasmuch as the convention is a postponed one, the previous decision to meet at Atlantic City was adhered to and the dates set are June 18 to June 25; the Master Car Builders' Association being held first, June 18 to 21, and the Master Mechanics' Association from June 23 to 25. While the executive committees felt that it would be advisable to hold all the sessions during one calendar week, it was not found feasible to make such an arrangement. Frank McManamy, assistant director, Division of Operation of the Railroad Administration, was present. The decision in favor of holding the usual exhibit of the Railway Supply Manufacturers' Association was strongly favored by all those present, the advantages to the younger men in railroad service and for visitors from other countries being very strongly presented. It was decided that all three associations unite in invitations to the representatives of foreign countries to attend the convention.

Headquarters, as in former years, will be in the Marlborough-Blenheim Hotel, and sessions will be held on the Million Dollar Pier. At a separate meeting of the executive committee of the Railway Supply Manufacturers' Association J. D. Conway was elected secretary-treasurer.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 6-8, 1919, Chicago.
American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.
American Railway Master Mechanics' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.
American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago.
American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.
American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.
Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.
Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.
Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, Albany, N. Y.
International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.
International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.
International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.
Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.
Master Car Builders' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 18-21, Atlantic City, N. J.
Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.
Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.
Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, January 27-29, 1919, Hotel Sherman, Chicago.
Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

Personal Mention

GENERAL

E. Langham, general purchasing agent of the Canadian Northern Railway System, has had his jurisdiction extended to include all the Canadian Government Lines, with headquarters in Toronto, Ont.

George E. Murray, whose appointment as electrical and mechanical engineer of the Grand Trunk Western Lines, with headquarters at Battle Creek, Mich., has been announced in these columns, was born on December 8, 1884, at Decatur, Ill. He began railway work with the Wabash in 1903, and two years later went with the People's Gas & Electric Company, of Defiance, Ohio. He returned to the Wabash in 1906 to install the machinery and equipment in the new car shops at Decatur, remaining with that road until 1910. He then became connected with the Chicago & North Western, where he had charge of electrical equipment in shops, and subsequently was made chief electrician of that road, which position he held until he recently went with the Grand Trunk Western Lines, as noted above.

R. D. Quickel, having been released from military service, has been reappointed fuel agent of the Southern Railroad and associated roads, lines west, with headquarters at Cincinnati, Ohio, succeeding N. C. Kieffer, assigned to other duties.

Samuel J. Hungerford, general manager, eastern lines, of the Canadian Northern, has been appointed assistant vice-president of the Canadian Northern Railway System and the Canadian Government Railways, with headquarters at Toronto, Ont. Mr. Hungerford was born on July 16, 1872, near Bedford, Que. He was educated in the common and high schools and began railway work in May, 1886, as a machinist apprentice on the South Eastern and later served with its successor, the Canadian Pacific, at Farnham, Que. He was then machinist at various places in Quebec, Ontario and Vermont. From August, 1897, to February, 1903, he was consecutively chargeman, at Montreal; assistant foreman at Farnham, Que., locomotive foreman at Megantic, general foreman at McAdam Junction, N. B., and locomotive foreman at Cranbrook, B. C., on the Canadian Pacific. In February, 1903, he was appointed master mechanic on the Western division at Calgary, Alta. The following January he became superintendent of locomotive shops at Winnipeg, Man., and four years later was appointed superintendent of shops at the same place. In March, 1910, he became superintendent of rolling stock of the Canadian Northern and the Duluth, Winnipeg & Pacific, at Winnipeg, Man., and in May, 1915, was transferred in the same capacity to the Canadian Northern at Toronto, Ont. On November 1, 1917, he was appointed general manager, eastern lines, of the Canadian Northern, which position he held at the time of his recent appointment.

S. J. Hungerford

James H. Rader, gang foreman of the Atchison, Topeka & Santa Fe at Emporia, Kans., has been appointed apprentice instructor in charge of schools at La Junta and Pueblo, Colo. His headquarters are at La Junta. Mr. Rader entered the employ of the Santa Fe about nine years ago as a machinist apprentice. After serving his apprenticeship he worked as a machinist until February 26, 1917, when he was appointed assistant apprentice school instructor at Topeka, Kans., and on May 1, 1917, he became gang foreman at Emporia.

W. L. Robinson, supervisor of fuel consumption of the Baltimore & Ohio, Western Lines, Dayton & Union, and the Dayton Union Railroad, has been appointed superintendent of fuel and locomotive performance, and his former position has been abolished.

G. W. Seidel, superintendent of motive power and rolling stock of the Minneapolis & St. Louis, has been appointed superintendent of motive power of the Chicago & Alton and the Chicago, Peoria & St. Louis, with office at Bloomington, Ill., succeeding J. E. Ohearne, resigned.

C. D. Young, formerly superintendent of motive power of the Pennsylvania Railroad, eastern lines, with office at Wilmington, Del., has been appointed acting superintendent of the Schuylkill division, succeeding William Elmer. Mr. Young resigned in November, 1918, as superintendent of motive power to become a lieutenant-colonel in the transportation corps, engineers.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

C. A. Fisher, a locomotive engineman on the Spokane division of the Great Northern, has been promoted to road foreman of engines of the first district, Spokane division, with headquarters in Hillyard, Wash.

G. R. Galloway, master mechanic of the Baltimore & Ohio, at Lorain, Ohio, has been appointed general master mechanic of the Baltimore & Ohio, Western Lines; the Dayton & Union, and the Dayton Union Railroad, with office at Cincinnati, Ohio, succeeding P. H. Reeves, assigned other duties.

M. A. Gleeson, master mechanic of the Baltimore & Ohio, Western Lines, at New Castle Junction, Pa., has been appointed master mechanic of the Cleveland division, with office at Lorain, Ohio, succeeding G. R. Galloway.

Erik W. Lostrom has been appointed road foreman of engines of the Northern Pacific, with office at Duluth, Minn., succeeding Charles Emerson, promoted.

T. F. Perkinson, master mechanic of the Baltimore & Ohio, with headquarters at Baltimore, Md., has been transferred to Cumberland, Md., as master mechanic.

Zill Pierce has been appointed master mechanic of the Saratoga and Champlain divisions of the Delaware & Hudson, with headquarters at Colonie, N. Y., succeeding A. L. Moler, resigned.

J. A. Tschour, general foreman in the locomotive department of the Baltimore & Ohio, Western Lines, at Willard, Ohio, has been appointed master mechanic of the New Castle division, with office at New Castle Junction, Pa., succeeding M. A. Gleeson.

Charles W. Weaks has been appointed road foreman of engines on the Toledo division of the Pennsylvania Lines West, with headquarters at Toledo, Ohio, succeeding R. Palmer, promoted.

CAR DEPARTMENT

M. H. Quinn has been appointed general car foreman of the Erie lines east.

R. B. Freeman, car foreman of the Seaboard Air Line, with office at Monroe, N. C., has been appointed general car foreman, with office at Hamlet, N. C.

G. E. Smart, superintendent of the car department of the Canadian Northern Railway System, has been appointed general master car builder, with jurisdiction over all lines of the Canadian Northern and the Canadian Government Railways, with office at Toronto, Ontario.

G. M. Waddy, general foreman of the Erie at the Buffalo car shops, has been appointed general car foreman of the lines west.

SHOP AND ENGINEHOUSE

J. B. Tynan has been appointed superintendent of the locomotive shops of the Wheeling & Lake Erie at Brewster, Ohio.

PURCHASING AND STOREKEEPING

R. C. Harris, supervising engineer for the Pennsylvania Railroad, Western Lines, at Columbus, Ohio, has been appointed general storekeeper, with headquarters at Pittsburgh, Pa.

C. W. Kinnear, assistant engineer of motive power of the Pennsylvania Lines West at Toledo, Ohio, has been appointed assistant general storekeeper, with office at Pittsburgh, Pa.

C. H. Rothgery has been appointed storekeeper of the Baltimore & Ohio, Western Lines, with headquarters at Lorain, Ohio, succeeding W. H. Dean, transferred.

FEDERAL ADMINISTRATION APPOINTMENTS

S. A. Bramlette has been appointed representative of the Division of Labor of the Railroad Administration, with office at Washington, D. C. Mr. Bramlette will be assigned to conduct investigations and to represent the Division of Labor in other specific matters to which he may be assigned affecting employees of the railroads under federal control.

C. E. Chambers, superintendent of motive power of the Central of New Jersey, has been appointed mechanical assistant to Charles H. Markham, regional director of the Allegheny region of the United States Railroad Administration, with headquarters at Philadelphia, Pa., succeeding J. T. Carroll, resigned, to go to the Baltimore & Ohio.

E. A. Clifford, assistant general purchasing agent of the Atchison, Topeka & Santa Fe at Chicago, has been appointed assistant to the Regional Purchasing Committee for the Central Western region, with headquarters at Chicago.

C. M. Freeman, traveling engineer on the Sunset-Central Lines, has been appointed assistant fuel supervisor of the Central Western regional district.

F. W. Marquise has been appointed assistant to the manager of the Fuel Conservation Section of the United States Railroad Administration, with office at Washington, D. C., succeeding Edward C. Schmidt, major, Ordnance Department, United States Army, who was temporarily assigned to service with the Fuel Conservation Section, but has returned to the service of the War Department.

OBITUARY

T. W. Heintzelman, formerly general superintendent motive power of the Southern Pacific, died of pneumonia in San Francisco, Cal., on December 11. After serving the Southern Pacific in various capacities for about 28 years he retired on January 1, 1917, on account of ill health.

SUPPLY TRADE NOTES

Joseph T. Ryerson & Son, Chicago, announce the opening of an office in Philadelphia, located in the Widener building.

The Cleveland Milling Machine Company, Cleveland, Ohio, announces that W. P. Sparks is now acting as its representative at Indianapolis, Ind., with office at 316 Terminal building.

The records in the offices of the mechanical department of the El Paso & Southwestern at El Paso, Tex., were lost in a fire on December 5. F. B. Lister has requested the supply trade to send catalogues to replace those destroyed.

George T. Cooke has resigned as eastern sales manager of the Vapor Car Heating Company, Inc., to accept the presidency of the Union Metal Products Company, Chicago, with office in the Singer building, New York. Mr. Cooke was born in Chicago on May 28, 1883. After receiving a technical and mechanical training he entered the employ of the Pullman Company in 1901 as draftsman. Later he was made chief draftsman of the Calumet repair shops, and subsequently was promoted to chief inspector and finally mechanical inspector. In 1911, he left the Pullman Company to become southern manager for the Chicago Car Heating Company, at Atlanta, Ga., and in 1913, he was transferred to this company's New York office as eastern manager. When the Chicago Car Heating Company and the Standard Heat & Ventilation Company, Inc., were absorbed by the Vapor Car Heating Company, Inc., in 1917, Mr. Cooke was made eastern manager, in charge of sales and mechanical matters in the eastern territory, which position he held until December 1, 1918, the date of his connection with the Union Metal Products Company as president.

G. T. Cooke

H. E. Passmore, formerly with the mechanical department of the New York Central and later production manager of the Marble Cliffs Quarries Company, has been appointed sales representative of the reorganized Grip Nut Company.

Roswell P. Cooley, who has had charge of sales in the southwest, with headquarters at Chicago, has been appointed to succeed Mr. Cooke, and Nelson T. Burns, formerly with the New York Central, has entered the sales department, with headquarters at Chicago.

Cyrus J. Holland has been appointed western representative of the Wine Railway Appliance Company, Toledo, Ohio, with offices at 730 Peoples Gas building, Chicago, succeeding the vice-president, R. F. Tillman, who has been assigned to other duties, with headquarters in Toledo.

The Walworth Manufacturing Company, with general offices at Boston, Mass., and works at Boston and Kewanee, Ill., with branches in New York, Chicago and Seattle, has recently purchased the business of Hunter & Dickson Company, at 241-247 Arch street, Philadelphia, Pa., and is operating it as one of its branches.

J. K. Mahaffey has been appointed sales manager of the Pittsburgh district with office at Pittsburgh, Pa., for the Edison Storage Battery Co., Orange, N. J. Mr. Mahaffey has been with the Edison Company for the last two years. He was identified for several years with the General Electric Company and a number of other electrical concerns.

Bertram Smith, heretofore district sales manager at Detroit, Mich., has been appointed assistant general sales manager of the Edison Storage Battery Company, with headquarters at the main office, Orange, N. J. Mr. Smith has long been engaged in the storage battery business, having formerly been with the National Battery Company.

George Simons, who has been associated with the Edison Storage Battery Company for the past three years, has been appointed to succeed Bertram Smith as district sales manager at Detroit, Mich. He has had valuable experience in storage battery practice, and was for nine years associated with the National Battery Company, Buffalo, N. Y., and with the United States Light & Heat Corporation.

The Truscon Steel Company, Youngstown, Ohio, which for many years has been manufacturing pressed steel parts principally for use in its own products, announces the expansion of its business into the manufacture of pressed steel parts of all kinds. The work will be handled by the pressed steel department, headed by G. F. Danielson, as manager, who for 25 years has devoted his entire efforts to the manufacture of pressed steel products.

Major William L. Allison, who for the past 18 months has been in active military service, has been honorably discharged from the U. S. Army and has resumed his duties as vice-president of the American Arch Company. In addition, Major Allison has been elected vice-president in charge of sales of the Locomotive Feed Water Heater Company. Major Allison was one of ten majors graduated from the first training camp at Fort Sheridan, Ill. That he, along with many others, were denied the opportunity of overseas service was a great disappointment to him. Major Allison was born near Salisbury, N. C. He graduated from the Davis Military School of Winston-Salem, N. C. For over three years he was in government service as deputy marshal. For six years he was employed in various capacities in the Baldwin Locomotive Works, Philadelphia, and in January, 1904, he became mechanical engineer of the Atchison, Topeka & Sant Fe. He resigned from the Santa Fe to become mechanical engineer of the Franklin Railway Supply Company. He was later western sales manager of that company, the Rome Merchant Iron Mills, the Economy Devices Corporation, and general western sales manager of the American Arch Company. He became vice-president of the latter company in January, 1914, which position he still holds in addition to the vice-presidency of the Locomotive Feed Water Heater Company.

Major Allison

The Brown Hoisting Machinery Company, Cleveland, Ohio, announces the following changes in its organization: Harvey H. Brown, chairman of the board of directors; Alexander C. Brown, president; Melvin Pattison, vice-president, general manager and director; Robert G. Clapp, director; John F. Price, director, and Ewen C. Pierce, general manager of sales.

The Independent Pneumatic Tool Company announces the opening of a branch office and service station in Cleveland, Ohio, on December 15. A complete line of Thor pneumatic and electric tools and repair parts will be carried in stock at 1103 Citizens building, under the management of Hayden F. White, who has represented the company in Detroit, Chicago and Milwaukee districts for some years past.

William P. Dalton, formerly for many years chief engineer of the Schenectady plant of the American Locomotive Company, has been appointed assistant manager of the Schenectady works of the General Electric Company. For the last three years Mr. Dalton has been with the Washington Steel & Ordnance Company, engaged in war work. He was graduated from Cornell University in 1890.

John E. Galvin has been elected president of the Ohio Steel Foundry Company of Lima, Ohio. Mr. Galvin has been operating vice-president since the organization of the company in 1907. In 1916 he built a converter and electric foundry at Springfield, Ohio, for the manufacture of small steel castings and later sold it to the Ohio Steel Foundry Company. This plant is now known as the Springfield works of that company.

R. W. Burnett has resigned as master car builder of the Delaware & Hudson to become associated with the Joliet Railway Supply Company as assistant to the general manager, and with the National Car Equipment Company as vice-president, with headquarters at Chicago. Mr. Burnett was born at Farmer City, Ill., in 1868, and in 1890 became connected with the Union Pacific in the car department at Denver, Colo. In 1892 he went to the Pennsylvania as a car inspector at Chicago, and from August, 1892, to July, 1899, was successively foreman and general foreman of the car department of the Lake Shore & Michigan Southern, at Chicago. During the early part of 1900 he was employed as general foreman of the car department of the Long Island, going to the Central Railroad of New Jersey the latter part of the year as general foreman of the car department at Elizabeth, N. J. From 1904 to January, 1907, he was successively assistant master car builder and master car builder of the Erie at Meadville, Pa. On the latter date he went to the Canadian Pacific as assistant master car builder, being made general master car builder in 1909. He left the latter road in November, 1915, to become vice-president of the National Car Equipment Company, returning to railway service on September 1, 1917, as master car builder of the Delaware & Hudson.


R. W. Burnett

L. E. Schumacher, who for the past eight years has been chief inspector of the Westinghouse Electric & Manufacturing Company, at East Pittsburgh, Pa., has been promoted to works manager of the Krantz Manufacturing Company, of Brooklyn, N. Y., the latest subsidiary of the former company. Mr. Schumacher has been with the Westinghouse Electric & Manufacturing Company for 18 years, prior to which he was with the Niagara Falls Power Company. The Krantz concern makes safety switches, panel boards and floor boxes.

S. D. Rosenfeld has been appointed district sales manager of the Franklin Railway Supply Company, Inc., with offices at Houston, Texas. Mr. Rosenfeld has had wide experience in railroad work and has brought out several inventions that improved locomotive operation. He was born at Lincoln, Neb., and received his early education at that place. Upon leaving college he entered the service of the Chicago & North Western, serving in the machine shop and signal department, and then as fireman and engineer. In 1912, Mr. Rosenfeld resigned as locomotive engineer and entered the service of the Franklin Railway Supply Company as mechanical representative, which position he held at the time of his recent appointment.


S. D. Rosenfeld

Lieutenant Clarence E. Holborn was instantly killed in an airplane accident at Call Field, Wichita Falls, Tex., on December 3. Lieutenant Holborn, previous to entering the military service, had been in the advertising department of the Hyatt Roller Bearing Company, New York. After leaving school he entered the service of the Simmons-Boardman Publishing Company, publisher of the *Railway Mechanical Engineer*, and for a number of years was connected with it in various capacities in the business and advertising departments.

H. W. Clarke, who until December 15, was connected with the advertising service department of the McGraw-Hill Company at Chicago, has been appointed manager of advertising for the Chicago Pneumatic Tool Company, Chicago. Prior to his connections with the McGraw-Hill publications he spent eight years with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., part of the time as a member of the sales and publicity departments, and later as western publicity representative, with headquarters at Chicago.

L. J. Kennedy, who for many years has been associated with the Consolidated Railway Electric Lighting & Equipment Company, died in Chicago on October 30. Mr. Kennedy was born in Watertown, N. Y., in 1880, but at an early age moved to Chicago and received his education in the public schools of that city. In 1900 he returned to the east and entered the employ of the Consolidated Railway Electric Lighting & Equipment Company as a machinist in the factory at Shelton, Conn. He was later employed as an inspector, taking care of car lighting equipment on various roads running into Chicago. Mr. Kennedy applied the first electric lighting equipment to the Golden State Limited and also to the Twentieth Century Limited. Later he had charge of the maintenance and operation of the lighting on those trains. After holding this position for some time, he was placed in charge of the manufacture and sales of the Consolidated company at Chicago, and later, when the Consolidated company discontinued its manufacturing in Chicago, Mr. Kennedy remained in charge of the sales only. In 1913 he left the employ of the Consolidated company to engage in boat building on the North Side of Chicago. Later he went to New Mexico on account of the health of his family and accompanied Pershing's Expedition into Mexico. In 1916, he returned to the employ of the Consolidated as sales engineer, but left the company again in 1917 to once more engage in the boat building business in which he was very successful in completing some large contracts for pontoons for the army.

Dr. Angus Sinclair

Angus Sinclair, D.E., founder and editor-in-chief of Railway and Locomotive Engineering, New York, died at his home in Millburn, N. J., on January 1, 1919, at the age of 78. Doctor Sinclair was born in Forfar, Scotland. He began his railroad career as a telegraph operator and later was a locomotive engineman on the Scottish Northeastern Railway. He attended evening high school and later for several years was employed in the Customs Department in Montrose, Scotland, and London, England. A love of adventure took him to sea, and, after some service as a marine engineer, he again took up railroad work in America, first in the service of the Erie, and afterward in the west, where he ran a locomotive on the Burlington, Cedar Rapids & Northern. During this period he attended the chemistry classes of the Iowa State University, making a specialty of water analysis, and was appointed chemist of the railroad, combined with the duties of roundhouse foreman. It was during this period that he first gave serious consideration to the problem of fuel economy and smoke prevention, on which he has since written extensively. In 1883 he joined the editorial staff of the American Machinist, a few years later becoming president of the publishing company. In 1887 the company, desiring to broaden its field, established the Locomotive Engineer, of which the late John A. Hill became editor. A few years later Doctor Sinclair and Mr. Hill bought this paper, now Railway and Locomotive Engineering, and since Mr. Hill's retirement from the partnership in 1897, Doctor Sinclair has been the sole proprietor and editor-in-chief.

Angus Sinclair

In 1908 the faculty of Purdue University, Lafayette, Ind., conferred upon him the honorary degree of Doctor of Engineering. About this time he was appointed special technical instructor in the mechanical department of the Erie Railroad. Doctor Sinclair has also been closely identified with the work of nearly all of the leading engineering societies in America and with some in Europe. He was the senior officer in point of continuous service of the American Railway Master Mechanics' Association, having been treasurer since 1900. Previous to that time he had served as secretary from 1887 to 1896. He was also a member of the Master Car Builders' Association, the American Society of Mechanical Engineers, and was instrumental in the establishment of the Traveling Engineers' Association, which was organized in his office in 1892. He was a delegate to three International Railway Congresses, at Washington, D. C., St. Louis, Mo., and Berne, Switzerland.

Doctor Sinclair is the author of a number of works on railroad subjects, some of which have become textbooks, including "Locomotive Running and Management," "Combustion in Locomotive Fireboxes," "Firing Locomotives," "Railroad Man's Catechism," "Twentieth Century Locomotives," and "History of the Development of the Locomotive Engine." His first published work, "Locomotive Running and Management," was begun while he was running a locomotive, and was made up entirely from personal observation. It has repeatedly been revised by the author and has passed through 26 editions, the last appearing in 1915. His work on "Firing Locomotives" has been translated into eight languages, including Chinese. In his long and varied career Doctor Sinclair has been a pioneer in the study and development of many practices pertaining to locomotive operation, which have now become well established, and his influence will long be felt in practical railroad operation.

The Whiting Foundry Equipment Company, Harvey, Ill., announces changes that have been made in its organization. The following men have left the company: F. A. Rundle, general superintendent; C. A. Hardy, sales manager; G. R. Brandon and P. A. Dratz, Chicago representatives. Samuel Moore, formerly general manager of the Bond plant of the American Radiator Company, is now general superintendent and the company will be represented in Chicago by George Ristine, formerly with the Pressed Steel Car Company. H. A. Wolcott, formerly with the McMyler Interstate Company, Cleveland, Ohio; E. V. Brown and Walter R. Hans have become members of the company's engineering staff.

Dr. Walter V. Turner

Dr. Walter Victor Turner, manager of engineering of the Westinghouse Air Brake Company, died at the Columbia Hospital, Wilkinsburg, Pa., Thursday morning, January 9. In the death of Doctor Turner the world has lost the greatest air brake expert of the age. Doctor Turner has had a most unique career, having by the fate of destiny entered on a work that has meant so much to American railroading. He was born in Epping Forest, Essex county, England, April 3, 1866. He was in the wool business in that country and came to America in 1888 to develop his education along those lines. He was secretary and manager of the Lake Ranch Cattle Company, Raton, N. M., in 1893. In 1897 this company failed and Doctor Turner entered the employ of the Atchison, Topeka & Santa Fe as a car repairer. In one month he was made gang foreman and three years later was made chief inspector. Having previously become interested in air brake apparatus through a bad wreck that occurred in the vicinity of his home, he made a very careful study of its intricacies in his new position and it was during the first year of his employ that he developed his first air brake patent. He soon gained a reputation for proficiency in air brakes and was placed in charge of the

Walter V. Turner

air brake instruction car on that road. From general air brake instructor he was promoted to mechanical instructor for the entire system, during this time having sold 22 patents to the Westinghouse Air Brake Company.

At the 1902 convention of the Air Brake Association, which was held in Pittsburgh, Doctor Turner was offered a position with the Westinghouse Air Brake Company, but refused. The offer was repeated again at the 1903 convention and in November of that year arrangements were made between the Air Brake Company and the Santa Fe to loan Doctor Turner to the former. That arrangement was continuously in effect to the time of his death. In 1907 he was made mechanical engineer; in 1910, chief engineer; in 1915, assistant manager, and in 1916, manager of engineering. The first task of Doctor Turuer with the Westinghouse Company was to develop the *K* triple valve, of which there are now over 2,000,000 in use. By his untiring energy and ingenuity the art of braking trains has developed by leaps and bounds. He has been granted over 400 patents and a hundred or more are still pending. Among his latest inventions the improved empty and load brake and the electro-pneumatic brake stand out pre-eminently. These made possible an increase of 300 per cent. in the capacity of the New York Subways. Doctor Turner was also an author, among the more important of his books being "Train Control—Its Development and Effect on Transportation Capacity," which was published in two volumes. He was awarded the Longstreth medal in 1911 and the Elliott-Cresson medal in 1912. He was a fellow of the Royal Society of Arts, England, and a member of the American Society of Mechanical Engineers, the American Electric Railway Association, Franklin Institute (Philadelphia), and the Pennsylvania State Chamber of Commerce. The degree, "Doctor of Engineering," was conferred on Doctor Turner by the University of Pittsburgh in 1918.

Doctor Turner's death was the result of complications, among them being enlargement of the heart and Bright's disease. He was injured two or three years ago in an automobile accident, to which he attributed his condition. He had been seriously ill since the middle of November. He leaves besides his widow, a married son and daughter.

William I. Thomson, electrical superintendent of the Safety Car Heating & Lighting Company, died at his home in Newark, N. J., on December 10 of pneumonia. Mr. Thomson was prominent in the field of railway car lighting engineering for many years, and to his efforts are due many important developments in car lighting electrical apparatus. He was born in Newark, N. J., June 26, 1876, graduated from Stevens Institute in the class of 1897, and served as chief machinist on U. S. S. Badger during the Spanish-American war. He was instructor in applied electricity at Stevens Institute from 1897 to 1900, and after working in the electrical construction department of the Manhattan Railway Company, New York, for two years he went to the Safety Car Heating & Lighting Company in 1902.

Fred C. J. Dell has been elected secretary of the National Railway Appliance Company, New York. Mr. Dell has acted in the capacity of secretary to the president of the company for the past two years, previous to which time he was connected with the American Electric Railway Manufacturers' Association as assistant to the secretary-treasurer. He held that position from March, 1911, to May, 1916, at which time he resigned to assume charge of the detail work of the exhibit committee for the 1916 convention of the American Electric Railway Association. In October, 1916, he was elected secretary of the American Electric Railway Manufacturers' Association, which position he still holds. He received his early training in the office of the vice-president and general manager of the Interborough Rapid Transit Company, where he was employed for a period of seven years.

CATALOGUES

PNEUMATIC HAMMER.—A six-page folder describing in detail the construction and operation of the Barr pneumatic high speed hammer has been published by H. Edsill Barr, engineer, Erie, Pa.

TANKS.—A list of the storage, pressure, car tanks, etc., for sale by the Walter A. Zelnicker Supply Company, St. Louis, Mo., with the dimensions and weight of each, is published in bulletin No. 252.

SMALL TOOLS.—Catalogue No. 40, listing taps, dies, screw plates and reamers manufactured by the Greenfield Tap & Die Corporation, Greenfield, Mass., has been issued by this company. It contains 288 pages, in which sizes, prices, dimensions and illustrations are given in convenient form.

TIGHT RIVETS.—The American Flexible Bolt Company, New York, has developed a new type of rivet, known as the American rivet, which is described in bulletin No. 301. It upsets from both ends, and because of this is claimed to make a tight rivet. Reproductions of actual photographs of plates sectioned for the purpose, are shown to illustrate this point.

ROME HOLLOW STAYBOLT IRON.—Bulletin No. 2 of the Rome Iron Mills, Inc., 30 Church street, New York, enumerates the advantages of Rome hollow staybolt iron and bears out a claim of economy with figures comparing the cost of this kind of staybolt iron per engine for the first year and each succeeding year, and the ultimate cost of solid iron, which must be drilled and frequently tested.

RESEATING MACHINES.—Bulletin G-2, recently published by the Lagonda Manufacturing Company, Springfield, Ohio, describes that company's electric, air, steam and water-driven reseating machines for boiler caps and headers. These machines are portable and are especially designed for use on boilers of the Babcock & Wilcox type, using ground joints between caps and cap seats in the headers.

HOISTING MACHINERY.—The equipment manufactured by the Brown Hoisting Machinery Company, Cleveland, Ohio, consisting of trolleys, traveling and portable cranes, electric hoists, etc., is presented in a complete and attractive catalogue, No. D-1919, containing 56 pages, 8½ in. by 11 in., and over 100 illustrations. A large amount of data is also given in tabular form as to prices, dimensions and clearances.

LOCOMOTIVE CONDULETS.—The Crouse-Hinds Company, Syracuse, N. Y., has designed several new condulets for use in electric headlight wiring on steam locomotives, which are listed and illustrated in bulletin No. 1000-1. A plan view and side elevation of a locomotive and tender wired with conduit and condulets, and sectional views of the installation are shown in the catalogue, with a list of the materials required. These drawings are complete insofar as it is possible to make them and they should be of value to anyone charged with the work of installing electric headlights.

FEEDWATER FILTER.—A multiple filtration feedwater filter and grease extractor designed for power plant work and manufactured by the Lagonda Manufacturing Company, Springfield, Ill., is described in some detail in Catalogue R, issued by that company. This is a compact, self-contained unit and the multiple filtration assures thorough cleaning by filtering and refiltering the water. The filtering element may be easily cleaned and used repeatedly. The catalogue contains a number of illustrations showing the construction of the filter and several installations, as well as a table of dimensions.

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CONTENTS

Thermic Syphons for Locomotive Fireboxes

It is a well-known fact that firebox heating surface is much more productive as a steam generating medium than any other part of the boiler, and some attempts have been made to increase the firebox heating surface by using a horizontal water leg in place of a brick arch. This method did not prove successful, due to the fact that it provided in effect a cold blanket over the fuel bed which hindered rather than aided the complete combustion of the gases, the purpose for which an arch is used. The most recent development along this line is that of the thermic syphons, which are described elsewhere in this issue. They consist of two triangular water legs extending down from the crown sheet to the throat. The fire bricks are supported on the long side of these water legs and the syphons form in effect three combustion chambers above the arch. Thus, the additional heating surface is located in the hottest part of the firebox and divides the flame into three sections, thus increasing its total radiating surface. With these water legs placed above the arch the combustion of the gases should be far enough along to prevent the formation of soot and smoke. This is further checked by the incandescent arch which forms one side of each of the three chambers. A much larger amount of radiant heat should thus be absorbed from the burning fuel than has hitherto been possible and as the amount of heat obtained by radiation is far greater than that obtained by the contact of the hot gases with the heating surfaces, a greater amount of heat from the fuel is utilized. The circulation through these syphons being exceedingly brisk a large amount of heat should be absorbed. This not only increases the evaporating efficiency of the firebox, but affects the entire boiler, as better circulation throughout the boiler should be obtained. The first installation of thermic syphons was made on the Chicago, Milwaukee & St. Paul about six months ago and the tests, which are reported on another page, show that a marked increase in evaporative efficiency was obtained.

Fundamentals in Autogenous Welding

The development of both oxy-acetylene and electric methods of welding metals has been rapid during the past few years. In many cases all that was deemed necessary was to place the apparatus in the operator's hands and after a perfunctory course of instruction set him to work with the thought that welding troubles were over. Many roads soon found, however, that there is much to learn in the handling of the apparatus if successful results are to be obtained. Some roads have developed far more rapidly than others and are doing work which has been impossible on other roads. The chief reason for this is that they have given the problem very careful study and have sought to get down to fundamentals. They soon found that in order to get good work and to weld difficult jobs that thorough instruction was necessary and this cannot be over-emphasized, for the possibilities for saving money by these methods of welding are great if they are handled properly.

There appears elsewhere in this issue an article discussing some fundamental facts regarding the oxy-acetylene process, in which it is shown that there are right and wrong methods of handling the torch. Of particular interest is the analysis of the oxy-acetylene flame and how easy it is by the improper manipulation of the flame to make a soldering rather than a welding job; also, how important it is that filler materials of proper characteristics should be used in order to obtain satisfactory work. It is these things that must be carefully studied in the handling of any welding process if success is to be attained. The man that thoroughly knows the subject, knows the materials with which he works and how to get the best results from them, is the one who will make the greatest saving and produce the best work. It is of fundamental importance that this be considered in any attempt to develop autogenous welders in railway shops.

Employment of Returning Soldiers

We read much in the newspapers concerning what is to be done with the returning soldiers. Too many of us look upon it as a government proposition. To a certain extent it is, of course, but to a very large extent it is up to every individual employer of men. The government should so regulate the affairs of the country that business will improve. It should insist that every one of its departments that involves the occupation of men proceed with the necessary construction to provide markets for the materials from the workshops of the nation and to provide labor for the men. It is not doing so in its department of railroad administration—the contrary is true. Purchases are held down to a minimum in spite of a large amount of deferred maintenance. Attempts have been made, however, to increase the opportunities for employment on the railroads themselves by the introduction of the eight-hour day, which requires three shifts in 24 hours where before two were used. The individual employer of men where he can possibly justify additions to his forces should take care of the returning soldier and particularly the man who has enrolled from his immediate vicinity. Justice requires that this be done. Those of our boys who do come back have served our interests well. They have saved our nation from disgrace and sorrow. Our responsibility to them does not cease with their disenrollment from service. Everyone must seek to make their re-entry into civil life a success.

Patriotism of Belgian Railway Men

It is impossible for American railroad men, not having been subjected to the horrors of invasion during the war, fully to appreciate what it meant to their brothers in Belgium and northern France. We might have had our own ideas as to what we would have done in case our land were invaded but it is practically impossible to realize what it would mean to us. An interesting sidelight on what it meant to the railway men of Belgium and how their patriotism was put to test is vividly given in an article recently published in the Railway Gazette of London. At the time of the invasion the railway engine drivers took as many locomotives into France as possible. Comparatively few mechanics, however, escaped in this way and due to the congestion, by no means all of the engines. Those that were left refused to carry on the service. At first German employees were brought into the country, but later as Germany's demand for men grew and because of many accidents caused by the unfamiliarity of the Germans with the peculiarities of the road, a strong endeavor was made to get the Belgian railway men to work. The Germans offered large increases in wages and as high as $10 a day to the enginemen, but the Belgians steadfastly refused. They and their families were told that they would be deported into Germany, but still this did not alter their attitude.

Railway officers and hundreds of men were put in prison, towns were penalized, but still the men did not give way. Throughout 1916 the German administration in Belgium took every step to increase unemployment with a view of forcing the men through distress to work in Germany. The railway men, however, were more valuable to the Germans in Belgium than in Germany and instances of pressure brought to bear on them, which amounted to regular persecution, are too numerous to mention. At Tournai the railway men were condemned to four months' imprisonment for refusing to work on German engines. Finding them equally obdurate at the end of their sentence it was increased to a year's imprisonment, during which time they nearly died of hunger. At Brussels, despite threats and pleadings, the railway men would give no assistance and finally the Germans ordered the banks to cease any payments of money to their wives and families, the men being deported into Germany, leaving their families to live under charity or to starve. The railway men resisted to the end. They were true to their country and even though they were not privileged to fight on the battlefield, by their patriotism and refusing to work for the Germans, they served their country's cause loyally, despite the privations and persecutions to which they were subjected.

Developments in Locomotive Design

In this issue of the *Railway Mechanical Engineer* is published a description of two of the most recent developments in the design of locomotives, both of which are intended to increase the efficiency of the machine and to reduce its cost of operation. Both are particularly noteworthy and make one think of the wonderful development made in locomotive design and locomotive accessories during the past 10 years. Whence have these improvements come? Who was it that developed them, engaging the best talent in the country for the purpose? There is hardly an improved mechanical appliance on the locomotive today that was not fostered and nurtured and developed by our railway supply fraternity, which has become a tremendously important institution in the railway field of this country. True, many of the embryonic ideas were obtained from railroad men, but the process of investigation, study and development has been carried on by the supply interests. Their incentive, of course, is profit, but the competition has been so keen under past conditions that they have had to provide a product with real merit if they had any hope of success. Under this competition these products have been developed to a high state of efficiency and their savings in the cost of operation have been such that the railroads have found it profitable to buy them. To be sure the railroads have co-operated with the supply companies in working out the designs to a logical conclusion by placing a sufficient number in operation so that the weak points might be determined and corrected.

The manufacturers of these devices have had under private ownership an open and scattered field, so that if a group of men on one railroad could not be convinced that the device was worth trying, there was still plenty of opportunity for convincing others, where, perhaps, operating and maintenance conditions were more favorable, and there were very few meritorious devices that did not find an opening on some road in the United States. Under government control these manufacturers have but one chance to get their devices tried, and that rests with a central committee at Washington which, with such a large task before it, would naturally become over conservative. It is evident, therefore, that with this greatly narrowed field it will be far more difficult to introduce and develop improvements than was formerly the case. In order to get an idea of our condition 10 years hence, under the existing conditions, one has but to think of what has been accomplished during the past 10 years under private management. Would we have had the air brakes we have today? Would the brick arch have been in such extended use as it is today? Would an attempt have been made to introduce feedwater heaters, reverse gears, stokers, superheaters and the many other noteworthy improvements which have met with success? Does this nation realize what an important factor the railway supply interests have been in the development of railway equipment? To remove their incentive for further development and to make it more difficult for them to introduce improved devices will seriously retard further growth.

Equipment Standardization in England

As in the United States the germ of standardization has taken root in England. Sir John A. F. Aspinall, general manager of the Lancashire & Yorkshire Railway, in a presidential address to the Institution of Civil Engineers, strongly opposed this tendency. The conditions in England are somewhat like those of the United States as far as the necessity for having several designs of locomotives to meet the physical conditions is concerned. They are unlike the United States in that a comparatively small amount of equipment was interchanged between the roads before the war. There has been, therefore, no demand for standardized details of construction as there has been in this country. Sir John, however, appreciates the possibility of standardizing to this extent, but argues strongly against extreme standardization.

Assuming that the possibility of seven types might serve the requirements of the English roads he calls attention to the fact that these types will have to be split up into various classes to enable them to deal with the work in all parts of the country without reducing loads. But he says, "Assuming that the seven types will do all the work, the question of maintaining those types for a long period of years depends on the march of progress; and if you look back over a series of years you will find that each period of, say, 10 years on some lines and 15 years on others, calls for great changes in the locomotive brought about by changes in traffic conditions." Thus he goes on to show that the number of classes must be increased in the future, for true economy demands that the machines be kept absolutely up to date.

The individual railway companies have, as in this country, developed an admirable system of duplication which it would be very costly to change and he points out that inasmuch as it would be impracticable absolutely to replace the present designs with standard designs, the transition period would at least extend over 25 years. This will be very expensive—"As the money to be saved on new construction will be trivial and will be much more than wiped out by the interest on the greatly increased value of stores at workshops and outdoor locomotive sheds, necessitated by the introduction of new parts." He quoted the address of Alba B. Johnson,* president of the Baldwin Locomotive Works, before the Chamber of Commerce last year and finds confirmation of Mr. Johnson's views in the growth of locomotive power in the United States during the past 15 years. In speaking of standardization as a bar to progress he says:

"In pressing forward the all-important question of the further standardization of parts, nothing should be done to prevent the acceptance of new ideas which tend toward the improvement of conditions and the economy of operation, though a nicely balanced judgment will often be required to decide between the acceptance of some excellent new idea and the economy to be maintained by the retention of parts which are absolutely interchangeable.

"In the world of mechanism there can be no finality, and we ought not to look forward to finality if we are to keep pace with other nations. The brightest ideas of many minds may easily be killed by over-standardization, and one has but to look at the motor car industry to see how the inventive brains of many of our countrymen have been stimulated by the varied requirements of motor travel to produce some of the most beautiful mechanism in a number of forms, many of special engineering merit. One trembles to think how the too enthusiastic theoretical standardizer could in this case have put a stop to practical progress, and sterilized the best efforts in this great modern industry, while the well thought out standardization of many details and minor parts has helped the manufacturer to purchase parts in a competitive market."

*See *Railway Mechanical Engineer*, May, 1918, page 246.

It is exceedingly interesting to read the opinion of so great a man as our neighbor across the sea on this tremendously important problem. It coincides with the thoughts of our ablest men in this country. We have only to think where we would be today had standardization as it was promulgated the first of last year been enforced 10 years ago to realize where we will be 10 years from now if the present plan of the Railroad Administration persists.

All Sorts of Plans for the Railroads

Twice before, in recent history, railroad men, bankers, politicians and shippers have had an opportunity to air their theories of railroad regulation. Once, in 1914, before the Hadley commission, and once, in 1916-17, before the Newlands committee, but never before has there been such an opportunity as at present for general publicity for different theories of railroad regulation. During the entire month of January the Interstate and Foreign Commerce Committee of the Senate was in session, hearing whomsoever could speak with some show of authority on this question. Probably the most important testimony was that given by the Interstate Commerce Commission, the counsel and representatives of the railway executives, and the representatives of the Association of Owners of Railroad Securities. Naturally, the Interstate Commerce Commission was for an extension and a continuation of its authority with the right to fix minimum as well as maximum rates and to pass upon new issues of railroad securities.

The outstanding feature of the railway executives' plan was the creation of a new cabinet office with a secretary of transportation to fill this office. His duties would be that of assuming the responsibility for adequacy of rates. In addition, railroad companies would be permitted to incorporate under federal laws instead of state laws, and federal regulation would be substituted for state regulation.

The Association of Owners of Railroad Securities, which is an association formed by S. Davies Warfield, president of the Continental Trust Company of Baltimore, with a membership consisting of insurance company officers, savings bank officers, etc., is opposed to the secretary of transportation idea and to federal incorporation, but wants a law passed which will guarantee to the railroads rates sufficient to yield a minimum fixed return on their securities.

It will be seen that in all of these plans, the maintenance of healthy competition is essential. In other words, the dream of economies under a unified railroad administration is apparently recognized as a dream by nearly all the classes of men who are giving their views to the Senate committee. Even Clifford Thorne, representing various shippers, is opposed to government ownership and government operation. Only Mr. McAdoo and his successor in office, Walker D. Hines, continue to urge retention of the roads by the government for five years. The retirement of William G. McAdoo as director general, and the assumption of that office by the former assistant director general, Walker D. Hines, was effected without any immediately apparent change in policy of the Railroad Administration. Mr. Hines takes up the task of urging a five-year retention of the roads in the same vigorous spirit that Mr. McAdoo gave to it.

NEW BOOKS

Proceedings of the Traveling Engineers' Association. Edited by W. O. Thompson, secretary. 478 pages, 6 in. by 8½ in., illustrated, bound in leather. Published by the association, W. O. Thompson, secretary, care of general offices, New York Central, Cleveland, Ohio. Price $1.

This is the official report of the twenty-sixth annual meeting of the Traveling Engineers' Association, held in Chicago September last, which was one of the most successful conventions ever held by this association. The subjects discussed covered particularly the duties of traveling engineers and the opportunities they had for helping the nation win the war. Fuel economy was practically the keynote of the entire convention, and much valuable information was presented on this subject. Several interesting subjects of more technical interest were discussed, among them being proper maintenance of locomotives, superheater performance, improvement in the air brake service and maintenance, locomotive cab and cab fittings on modern locomotives, and engine failures. This volume contains an address by Frank McManamy, assistant director of operation, United States Railroad Administration, outlining the importance of the duties of the traveling engineer, and a paper on "The Railways in the War," by Samuel O. Dunn, editor of the *Railway Age*. Eugene McAuliffe, manager of the Fuel Conservation Section, presented a paper on railway fuel conservation.

The Starrett Book for Machinists' Apprentices. By Howard P. Fairfield, assistant professor machine construction, Worcester Polytechnic Institute, and Carl S. Dow, S.B., editor-in-chief Practical Mechanical Engineering and Practical Shop Work. Fourth edition, 176 pages, illustrated, 4½ in. by 7 in., bound in leather. Published by the L. S. Starrett Company, Athol, Mass. Price 50 cents.

While this book is essentially for the apprentice rather than the expert machinist, many machinists will find it of much interest and value, as it is intended to answer questions as to how to do the everyday work of the average machine shop. The aim in preparing the book was to select the elementary features most essential to the advancement of machinists' apprentices and students in technical and manual training schools. It is intended to give a portion of the instruction ordinarily given by the teacher or by more experienced machinists and will also serve as a reference book for data not to be memorized. The different classes of work are taken up separately; the most common errors are pointed out and the correct practice indicated. Attention is given to the proper use and care of tools, the reading of micrometers and verniers, bench work, lathes and lathe tools, grinding, belts, gears, etc. Distribution is being made exclusively through the hardware dealers handling Starrett tools.

An Investigation of Twist Drills. By Bruce W. Benedict and W. Penn Lukens. 139 pages, illustrated, 6 in. by 9 in. Bound in paper. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill.

This bulletin contains an account of a series of experiments to disclose certain facts regarding the performance of metal drills. One-inch drills of several standard makes, and cast iron test blocks made in the shop laboratories, were used. The power required for different speeds and rates of feed was noted in all tests and the thrust and torque of the drill were recorded by special dynamometers. The economical helix angle, point angle, clearance angle, speed and feed were determined, and the effect of pilot holes was shown.

Some of the more important points brought out by the investigation are the following: The lowest power consumption was attained with helix angles from 35 to 40 deg., while in cast iron an angle of 30 to 35 deg. gave the best average endurance. For drilling holes at depths of more than 3 in. a drill with a large helix angle gives the best results. In general a point angle of about 110 deg. seems more satisfactory than the usual angle of 118 deg. A peripheral clearance of 6 or 7 deg. showed the maximum endurance. An edge angle of 130 deg. is recommended for all but the heaviest feeds. This angle may be decreased for light feeds and increased for heavy feeds. Drills with concave cutting edges and large chip spaces showed the lowest power consumption and the greatest endurance. The endurance of a drill may be increased from three to ten times by simply rounding the sharp corners at the edge. This has the effect of preventing the corners from burning.

Bulletin No. 103 may be had gratis from the Engineering Experiment Station, University of Illinois, Urbana, Ill.

COMMUNICATIONS

THE SUBTLETY OF STANDARDS

LOUISVILLE, KY.

TO THE EDITOR:

There is scarcely a word more heavily laden with deceit than that of STANDARD. Its meaning is sadly misinterpreted even by men of intelligence. It conveys to the lay mind that something long in dispute and unsettled has been agreed upon. We think of it as something carefully worked over, hammered and boiled down until nothing remains but the essence. It suggests a system or device or a method which may be followed by the unknowing and assumes that that which has long been in a state of unrest and turmoil is forever out of the way, pigeon-holed, ticketed and labeled and finished. Tamper with what you may, criticise as you feel disposed, but keep away from that which is immobile, permanent, fixed—OUR STANDARD. Whose Standard?

While investigating one of our big new U. S. Standard Mikado engines, I found the throttle lever altogether too short for easy handling for the average engineer. Cab fittings and their proper location are among our most troublesome things for the reason that no two men will agree as to the exact location of anything. It has been our plan to take several opinions under advisement and, by pooling the ideas, select the best average and go ahead. By this means we think we have attained a fair degree of success and our cab arrangement is said to be good, in fact so much so that we are occasionally beguiled into speaking of it as "our" Standard.

As a matter of fact every new engine suggests modifications of one kind or another, and in riding with our men from point to point we get information regarding cab fittings and fixtures which cannot be had in any other way. Our cab arrangement is excellent, for our engines and our men are pleased with it, but under no circumstances would we say it is adaptable to every railroad. Our house appears to be in order and we like our furniture, then why should we discard that which suits a majority of our operators to adopt a doubtful design of another's invention? Standard Practice data are useful, very useful, but they must not be substituted absolutely for an experience which has proven its practice.

"Just as soon as we have become accustomed to the new order of things we may like the Standard better," I hear some one say. Not so. It is impossible to get used to a short throttle lever and equally impossible to do one's best with an inconvenient arrangement of cab fittings. Whose business is it to correct these things and see that they do not appear on the next lot of engines? Which of the manufacturers will take the pains incident to obtaining the information it has taken us years to accumulate? Whose standard is it that we are trying to swallow without making faces? The deceitfulness of riches is not to be compared with the deception lurking in the word "Standard."

It has gotten some of us into ten or fifteen years of extra trouble which we will doubtless pass on to our successors, an unwelcome heritage. We can hardly hope to outlive it. Those "three reasons * for standardizing locomotives" is the strongest possible testimony to the subtlety of the word which seems to have tricked a lot of old heads into thinking that the impossible might be pulled once anyhow on the unsuspecting.

MILLARD F. COX.

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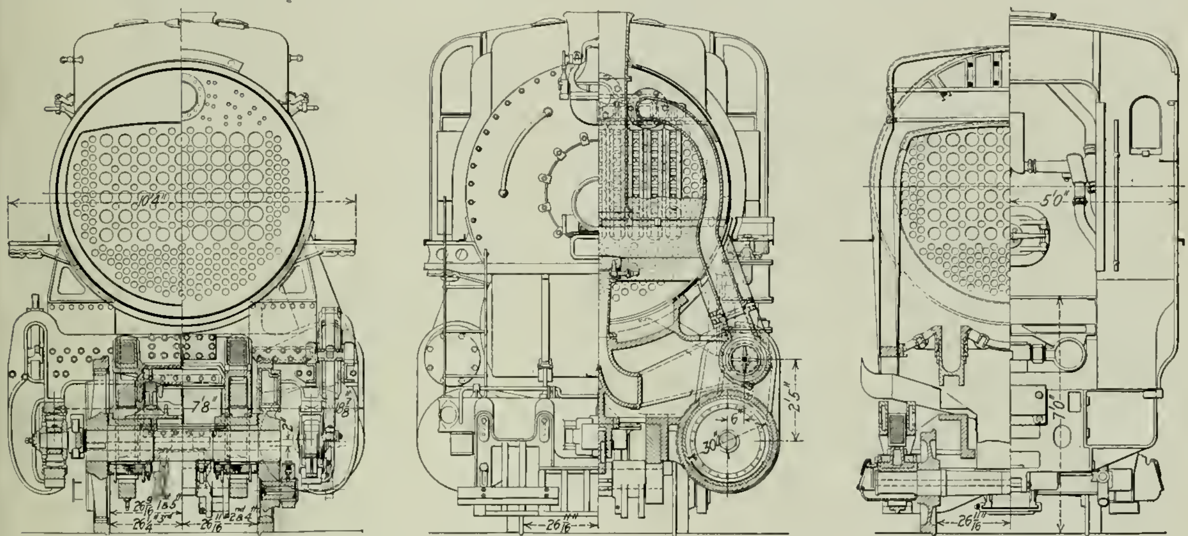
*See *Railway Mechanical Engineer* of January, 1919, page 2.

Pennsylvania Lines 2-10-2 Locomotive

New Features Include Four Point Suspension System, Two Radial Axles and Road or Switching Pilot

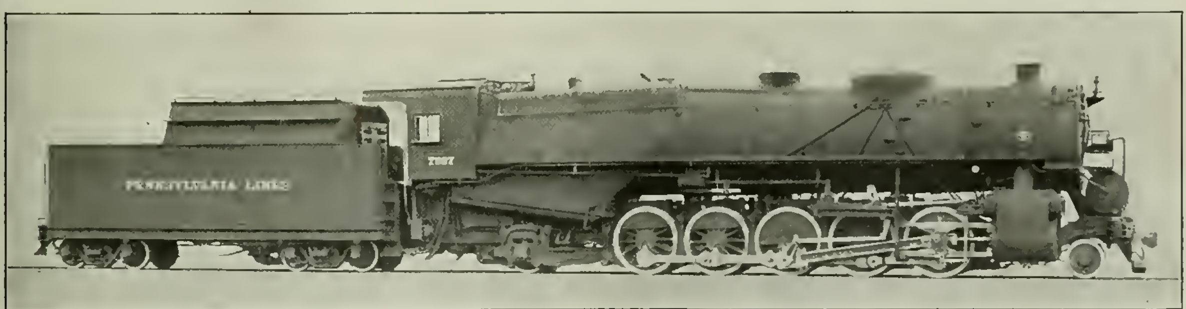
The Pennsylvania Lines West of Pittsburgh have recently received from the American Locomotive Company several locomotives of the 2-10-2 type which are notable for two reasons. The total weight is greater than for any engines of this type previously built, and yet they are able to operate on 23 deg. curves. Although these locomotives are extremely heavy they are in service on a division with low grades. All that have been received thus far are on the lines running from Conway Yard, near Pittsburgh, Pa., to Ashtabula, O., and Erie, Pa. The majority of the traffic being handled is ore moving from Ashtabula to Conway and coal from Conway to Ashtabula. The ruling grade on this line is 0.3 per cent, and the engines are handling approximately 85 loaded ore cars. The locomotives have a rating of 7,100 adjusted tons which amounts to about 6,000 actual tons.

The Consolidation type has long been the standard for freight service on the Pennsylvania Lines West of Pittsburgh. The recent designs developed practically the limit of the tractive effort obtainable with four driving axles. As the traffic conditions demanded heavier motive power it was felt that the increase in tractive effort which would be secured with the Mikado type would be so slight that it was best to go to the use of five driving axles. This 2-10-2 type, which is known in the company's classification as the N-1s, was therefore designed. Orders have been placed with the American Locomotive Company for 35 of these locomotives, and 25 are to be built at the Baldwin Locomotive Works.



Sections of Pennsylvania Lines West 2-10-2 Type Locomotive

Locomotives with five coupled pairs of driving wheels and a lateral motion driving box on the front axle cannot traverse curves sharper than 16 deg. In order to enable these engines to pass 23 deg. curves both the front and rear drivers are fitted with the Woodward floating axle. The tires on these wheels are set 53⅛ in. apart, and the main driving wheels have blind tires. In order to permit of coupling on sharp curves a pilot drawbar with a long shank is used and the pilot beam casting is cored out where the coupler enters, so that it can swing some distance on either side of the center line.

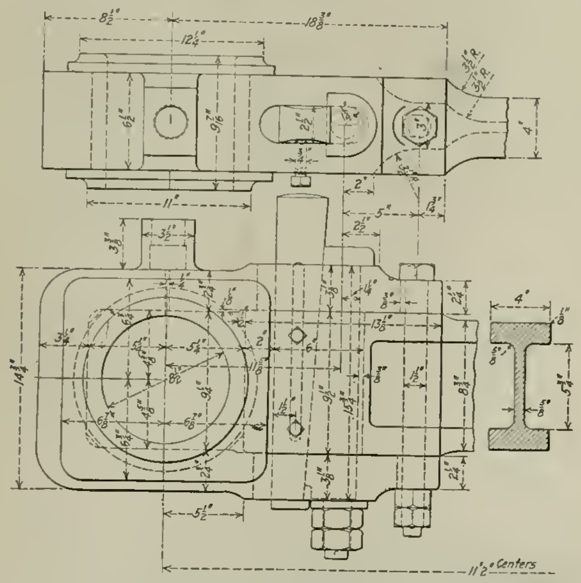


2-10-2 Type Locomotive for the Pennsylvania Lines West

While designed primarily as a road engine this type is well adapted for use in hump yard service. A unique design of cast steel road and switching pilot worked out by representatives of the Pennsylvania Lines West has been applied which makes it possible to use the engine in either service without the delay incident to removing the pilot and applying footboards or vice versa. Details of the pilot are shown in one of the illustrations.

The equalizing system is a very unusual departure from standard American practice. Instead of the three point suspension introduced by Eastwick & Harrison in 1838, which has been universally used in this country for many years, a four-point suspension has been adopted. The leading truck is equalized with the front pair of driving wheels, the three center pairs of driving wheels on each side are equalized together and the rear pair of drivers are equalized with the trailing truck.

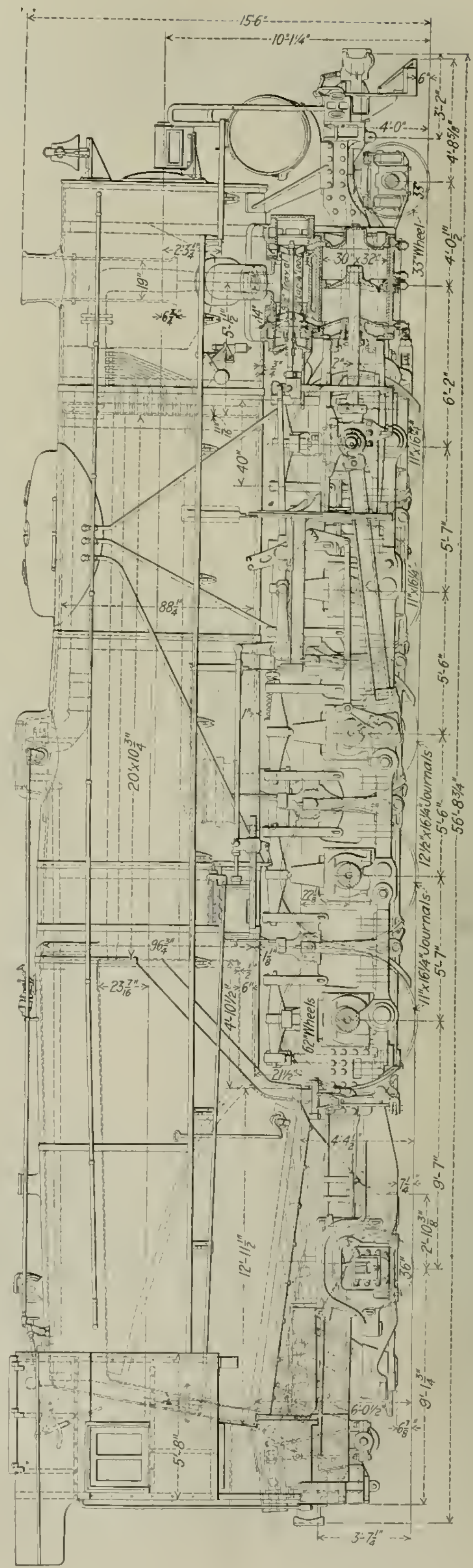
The valve motion which is of the Walschaert type, has an extremely long travel. While a full gear travel of seven inches has usually been considered the maximum that could be attained with this type of valve motion the design used on these engines gives a travel of 8½ in. The long travel is secured without excessive angularity by the use of a long radius rod and a long link combined with an eccentric crank of large throw. A similar arrangement has been in use for some time on a Consolidation locomotive, and the results ob-



Back End Main Rod; Pennsylvania Lines West 2-10-2 Locomotive

tained have demonstrated that the theoretical advantage of the long travel is borne out in actual practice. The steam lap of the valve is 1⅛ in. and the lead ¼ in. The 14-in. piston valve has a long spool and the passages to the cylinder are made as short and direct as possible. The cylinders, which are 30 in. in diameter with a 32-in. stroke, have a Z-shaped piston with a cast steel center and a cast iron bull ring. The cylinder lubrication is effected by a two-feed force feed lubricator which is attached to the left steam chest. A two-feed hydrostatic lubricator located in the cab is provided to supply oil to the air pumps and the cylinders of the stoker engine.

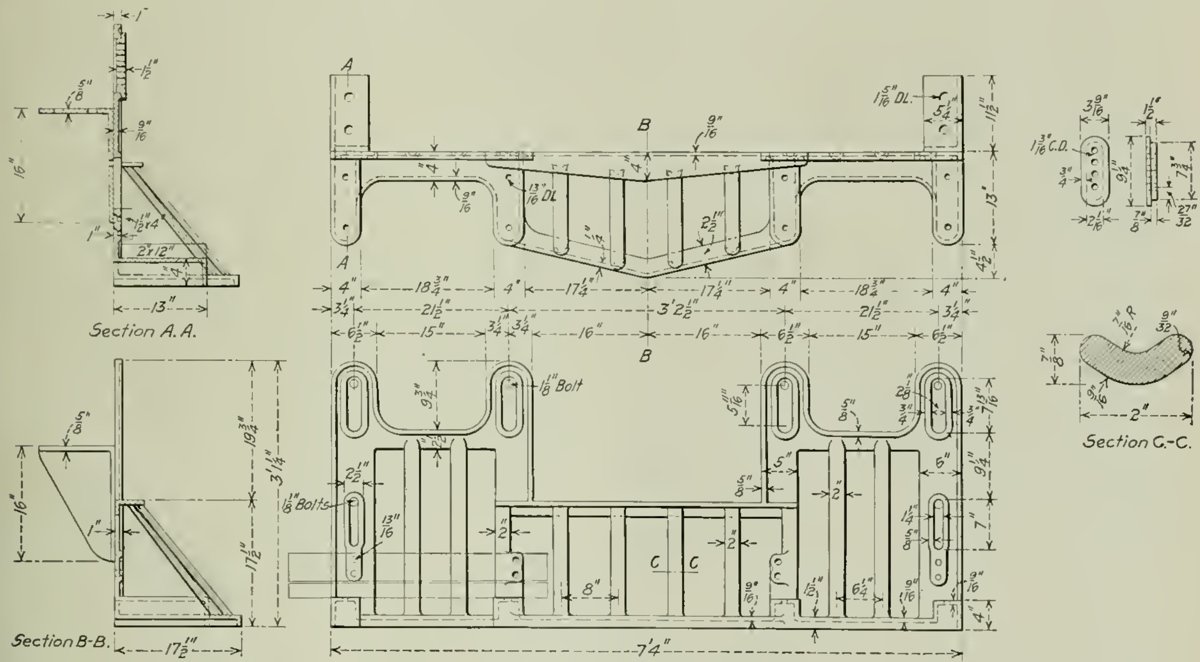
The boiler has been designed with a view to securing adequate firebox volume, and a large fire area through the tubes. The firebox is fitted with a brick arch and has a combustion chamber approximately 5 ft. long. There are 54 flues of



Elevation of Pennsylvania Lines West 2-10-2 Type Locomotive

5½ in. diameter, and 196 tubes 2½ in. in diameter. While the total heating surface is decreased by the use of the larger tubes, experiments have demonstrated that as tubes are lengthened beyond a certain point the evaporation does not increase proportionately. The most desirable ratio of length to internal diameter is approximately 100, and by using 2½ in. tubes this ratio is secured. Although the locomotives are now operating with a boiler pressure of 205 lb., the boiler is designed to carry 250 lb. The weight on the driving wheels is sufficient to permit of securing additional tractive effort, still maintaining a satisfactory factor of adhesion. The Crawford underfeed stoker is applied to these locomotives. The driving cylinder is placed in inclined position on the left side of the engine.

The location of the main reservoirs presented a difficult problem. It was finally decided to place a 36-in. diameter reservoir ahead of the cylinder saddle. The braces leading from the smoke box to the frame are steel castings, which also serve to support the reservoir. A three-rung ladder leads from the pilot beam to the running board. The air piping is arranged under the running board bracket, which is designed especially to receive it. Two sets of 13-in. by 12-in. brake cylinders are set between the first and second drivers, both working on the same levers and operating the shoes on all five pairs of driving wheels. An 8½-in. cross compound compressor is used. Among the specialties applied are Pyle National headlight, Commonwealth locomotive cradle, and Delta trailing truck, Ragonnet power reverse gear, and Barco flexible joints.



Cast Steel Pilot for Both Road and Yard Service

The principal dimensions and ratios of the locomotives are as follows:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	80,942 lb.
Weight in working order	435,400 lb.
Weight on drivers	351,300 lb.
Weight on leading truck	23,100 lb.
Weight on trailing truck	61,000 lb.
Weight of engine and tender in working order	642,400 lb.
Wheel base, driving	22 ft. 2 in.
Wheel base, total	41 ft. 11½ in.
Wheel base, engine and tender	82 ft. 7¼ in.

Ratios

Weight on drivers ÷ tractive effort	4.34
Total weight ÷ tractive effort	5.38
Tractive effort × diam. drivers ÷ equivalent heating surface*	701.67
Equivalent heating surface* ÷ grate area	89.4
Firebox heating surface ÷ equivalent heating surface,* per cent	5.21
Weight on drivers ÷ equivalent heating surface*	49.1
Total weight ÷ equivalent heating surface*	60.9
Volume both cylinders	26.18 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	273.1
Grate area ÷ vol. cylinders	3.06

Cylinders

Kind	Simple
Diameter and stroke	30 in. by 32 in.

Valves

Kind	Piston
Diameter	14 in.
Greatest travel	8½ in.
Outside lap	1⅛ in.
Inside clearance	⅛ in.
Lead in full gear	¼ in.

Wheels

Driving, diameter over tires	62 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	12½ in. by 15 in.
Driving journals, others, diameter and length	11 in. by 15 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	36 in.
Trailing truck, journals	7½ in. by 13⅞ in.

Boiler

Style	Conical Belpaire firebox
Working pressure	†205 lb. per sq. in.
Outside diameter of first ring	90¼ in.
Firebox, length and width	80 in. by 144 in.
Firebox plates, thickness— Back and sides ⅜ in., crown 7/16 in., throat ½ in., tube 9/16 in.	
Firebox, water space	6 in.
Tubes, number and outside diameter	196, 2½ in.
Flues, number and outside diameter	54, 5½ in.
Tubes and flues, length	20 ft. 10¾ in.
Heating surface, tubes and flues	4,302 sq. ft.
Heating surface, firebox, including arch tubes	423 sq. ft.
Heating surface, total	4,725 sq. ft.
Superheater heating surface	1,618 sq. ft.
Equivalent heating surface*	7,152 sq. ft.
Grate area	80 sq. ft.
Center of boiler above rail	10 ft. 1¾ in.

Tender

Tank	Rectangular water bottom
Frame	Cast steel
Weight	207,000 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	20 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.
†Designed to carry 250 lb. per sq. in. pressure.

Recent Papers on Fuel Conservation

Abstracts of Railway Club Papers Prepared by Fuel Experts Describing Methods for Saving Coal

PAPERS on fuel conservation were presented recently at the New England Railroad Club and the Southern and Southwestern Railroad Club by Robert Collett and B. J. Feeney, respectively, both of the Fuel Conservation Section of the Railroad Administration. A letter was also circulated by Joseph Harrington of the Fuel Administration, on the removal of soot by burning salt. All three of these are abstracted below:

IMPORTANT POINTS IN FUEL CONSERVATION

BY ROBERT COLLETT
Assistant Manager Fuel Conservation Section, U. S. Railroad Administration

A recent request from General Pershing called for six million tons of fuel to be shipped abroad. Our present shipbuilding program was estimated to require fourteen million tons of coal, merely to make and transport the steel. And for the eight million tons of vessels, it will require five tons of coal for each ton of shipping which leaves the ways. Each 15,000-ton ship that leaves our harbors for Europe consumes about 3,000 tons of coal or 12,000 barrels of fuel oil. Before the war, ships coaled abroad and made the round trip. Now the reverse is true. We can readily see, therefore, that the need for conservation, aside from cost is such as to challenge our best efforts. By reason of the large corps of fuel inspectors under the Federal Fuel Administration, aided by the railroad fuel inspectors, who have also been given federal authority, the general quality of the fuel has been, and will continue to be, very much improved. The miners have responded wonderfully. Better car movement has also helped.

ORGANIZATION.

It is our recommendation that one general man without other duties than fuel conservation, be charged with general supervision, reporting to the chief operating or chief mechanical officer; if to the latter, it should be understood by all departments that matters so requiring will be referred to the chief operating officer whose support, it is needless to add, will be given all practicable suggestions. The particular reason for this is, that many features vitally affecting fuel performance can only be handled as a system matter. The monthly fuel cost should be furnished at the earliest possible date after the close of each month to all divisional as well as general officers, and be made a subject of discussion at staff meetings. The plan of having fuel conservation committees, as a number of roads now have, is a good one.

Where practicable, each road foreman of engines or supervisor should have a certain number of crews and engines and be thoroughly familiar with the fuel costs in such service. We will assume one road foreman of engines with an assistant, and one traveling fireman—which is more supervision than is usually provided—has 50 engines in service at all times under his direction. At present costs these 50 engines are worth, if at all modern, we will say $40,000 each, or a total of $2,000,000. We will estimate they will burn 300 tons of coal each month at $6 per ton, a fair average for New England; this gives a fuel cost of $1,800 per engine per month, a total of $90,000 per month, or $1,080,000 per year. This supervision then is virtually responsible for the proper operation for every minute it is in actual service, of $2,000,000 worth of machinery and the proper use, so far as the work of the crew is concerned, of $1,080,000 worth of fuel annually. It is very natural, therefore, they should be anxious to make a good return for their stewardship.

PERSONAL EXPERIENCES ON A LARGE ROAD.

Several years ago the writer was assigned to the work of fuel economy on quite a large railroad, reporting directly to the general manager. In this experience I early learned that the one thing that goes further than anything else in obtaining results, is the unqualified support of the officers—from the chief operating officer down—which should be manifested by a personal interest *in*, and familiarity *with*, what is going on in the work. The important factors which it was my duty to study and control, as outlined by the general manager, were as follows:

Waste of fuel by reason of engines being delayed on the road.
Waste of fuel by engines being kept under steam unnecessarily at terminals.
Improper handling of the engine.
Excessive use of fuel by firemen.
Engines not in good condition.
Fuel not up to contract specifications.
Shortage of coal reaching pockets.
Fuel used for other purposes and improperly charged to engine use.
Any other matters that may require attention.

Locomotive Performance Sheet.—By the performance sheets we were enabled to make a very close study of fuel distribution, that is, the charges to individual engines and other miscellaneous purposes. A daily record was kept by charging the coal consumed on each trip, including that used at terminals, against the gross ton-miles in freight service and passenger car miles in passenger service for the trip. We found that no matter how closely we watched the distribution feature and although the law of averages worked out very satisfactorily for a given class of service, we could not depend on the performance sheet alone to locate excessive consumption. There are so many factors that can influence the performance even on similar runs, that a very close personal knowledge of the conditions of all of the locomotives and also close contact with the crews, shop forces and despatcher's office is necessary.

Waste of Fuel by Engineers Kept Under Steam Unnecessarily at Terminals.—It had been the practice with us and it is not at all uncommon for the mechanical department to keep engines ready for service at all times. This method was reversed and the transportation department gave three hours' notice for the required engines. All of the time above three hours the engines were held under steam, was charged at a rate determined by tests for the various class of service and considered as excessive fuel used at the terminal. This is a matter for local handling, but requires very close watching. Firemen instructors should spend a certain portion of their time educating fire-tenders and there should be terminal fuel committees, consisting of the master mechanic, yardmaster, and others. Proper division officials should be looked on as responsible for economical use of fuel at terminals, including stationary plants.

Improper Handling of Engines.—Engineers are quite naturally anxious to make a good performance. The statement has sometimes been made that "You can't teach an old dog new tricks." That is not my experience. Any man who can successfully hold down a job of running an engine over a period of years, I maintain not only *can*, but has the disposition *to* learn the most economical methods of operation. We will presume a man is not quite so skillful with the reverse lever and throttle or injector as some other men. Let the road foreman or supervisor go with him and say, "We want to see, or the boss wants to know, what is the best that can be done on this run in the way of fuel. I may make a few suggestions, but I will take the responsibility for making the time, etc." He may even handle the engine or fire for a part of the way. Let a note of commendation come back from the general manager or superintendent on the good performance and you will find that it will have the effect of encouraging any man to make a close study, as to how he can improve his methods. Another thing, the enginemen see things neglected which to them seem of great importance, and which causes them to believe that fuel economy is not really so much the desire of the management, or they would have been corrected. It is desirable that the crews be advised as to what steps are taken to remedy defective conditions which come under their observation and to which they call attention.

Excessive Use of Fuel by Firemen.—Not unlike many other roads, our plan was to give new firemen a letter to be signed by three different engineers, when in their opinion he was qualified. We found they did not always ride with crews who were the best instructors. We then arranged to select the crews they should ride with and whom we knew would train them properly. We also established the first, second and third year progressive examinations and made a rule that as nearly as practicable, the road foreman of engines would approve the application of new firemen before they entered the service for pay. In the past eighteen months scarcely any rule would apply in the employment of new men, but speaking in general it is possible to attract good men for the position of locomotive firemen.

I believe it worth while to maintain a competent force of traveling firemen or firemen instructors. There are always firemen on every division of the railroad who are very skillful, and the other firemen should be taught their methods. Everything depends on the new firemen getting a proper start and this has not been given enough consideration on the average railroad. The treatment accorded by the engineer, especially with new men, is important.

Engines Not in Good Condition.—Aside from the support of general officers and thorough co-operation between all departments, the condition of the locomotive is the greatest factor in the economical use of fuel. We will pass the matter of design and well known appliances with the statement that appliances, of whatever nature, tend to make the engine more complicated and require that they be properly maintained and operated. Certain devices operating under 100 per cent condition guarantee a certain result, but it is sometimes found that practically all of the benefits of the investment are lost by reason of lack of attention to detail, in its care.

Definite front-end and nozzle arrangements should be established and maintained at standards proven to be the most economical for the grades of fuel to be used. Air openings through ash pans should not be less than 15 per cent of the grate area, and preferably more than this. Tight steam pipes, front ends, tight valves and cylinder packing, grates properly maintained and first class steam distribution are the more important items. Engines cannot be in too good condition. If properly encouraged and especially if they know just what it means in dollars and cents in fuel costs, engineers will assist by their reports in keeping engines in good condition.

It is a good plan for the road supervision to ride engines for the first trip out of shop or during the breaking-in period, giving the shop superintendent or master mechanic a detailed report. These reports can be gone over at the staff meetings of the shop superintendent or the master mechanic with their foremen. We should also commend them for their good work. There should be the closest co-operation between the road supervision and the terminals and shops. It has been often stated that if all of the unnecessary work occasioned by improper reports could be avoided, all of the necessary work could be done.

SUGGESTIONS FOR FUEL SAVING

BY B. J. FEENY
Supervisor, Fuel Conservation Section United States Railroad Administration

The railroads are playing a very important part in the conservation of fuel, as they fully realize the importance of so doing not only because it is a part of the government conservation program, but also on account of the great increased cost of fuel, coupled with the increased cost of labor and materials. At all fuel conferences great stress is laid on the necessity of good locomotive maintenance, constant education of enginemen and firemen, hearty co-operation and a more complete and thorough understanding of the importance of fuel conservation by operating officers. All these things can be accomplished if an effective organization is put on each railroad. There should be a general staff officer in charge of fuel conservation, who should give his entire attention to the conservation of fuel on locomotives, in shops, at terminals, at water stations and for all miscellaneous purposes. He should also give attention to the preparation of fuel received, to its quality and should direct its transportation to and its handling at fuel stations.

Constant and good supervision is necessary to promote fuel conservation, so that all users of fuel may be taught to use it economically in the shortest possible time. We must constantly train our enginemen and firemen so that they will get the highest degree of economy which is consistent with good practice. They should know that every available bit of energy is produced by the fuel that is burned. What good results could be accomplished if the engineers and firemen would have in mind the saving of coal from a point of working the engine to the best advantage, with a view of getting results in the most economical manner. The enginemen should have the assistance of all officers and employees who have anything to do with the purchase, handling and preparing of fuel for use. Fuel economy starts with its purchase and ends at the cinder pit.

The coal on the tender should be used while it is in the best condition and should not be carried on tenders from shopping to shopping. Any practical device that will move coal forward to the fireman should be put on the locomotive tender. Shoveling coal forward, in the absence of a coal pusher, will answer the purpose. The supplying of coal to locomotives should be similar to the method of supplying oil. Daily experience indicates that the coal ticket as prepared by the engineer is not dependable; the coal chute foreman is the best judge of the amount of coal delivered to each engine.

An important subject that should be followed up is the firing up of locomotives in advance of leaving time. The practice of keeping locomotives under steam should be discontinued. Where a locomotive is fired up a long time in advance of leaving time, the front end netting becomes stopped up and the fire becomes dirty, which often results in the engine not steaming and failing on the road. To provide a safe margin, two or three hours before leaving time is early enough to start a fire in a locomotive intended for any service. Any small defect that heat would produce would make itself apparent in sufficient time to permit workmen to correct it or furnish another engine without delay.

There are advantages other than saving of coal in permitting engines to cool off. Workmen are offered more opportunity to work around cool engines; and they permit any character of inspection and good workmanship. The liability of engines moving while under steam is eliminated and there is no expense for engine watchmen to put water in locomotives standing partly fired, which causes damage to flues and firebox; it also avoids unnecessary moving of engines. There is not an element of locomotive maintenance that does not in some degree affect fuel consumption. We should organize and concentrate roundhouse forces so that all work is done on washout and monthly boiler inspection days. This also will allow for quick turning of power on all other days.

In starting fires in locomotives considerable green coal falls through the openings in the grates. After an engine is taken out of the roundhouse the ash pans should be dumped and the coal reclaimed. In many instances there is enough green coal left in the ash pan to haul one thousand tons of freight one mile. Locomotives tying up at points where no roundhouse facilities are available should have their fires banked when the engine is placed at rest and the fires should not be cleaned until two hours before the listed time. This allows the fire cleaner an opportunity to work with cold ashes instead of a hot fire. The ashes remaining in the locomotive all night prevent air from passing through the grates and flues, consuming fuel and reducing the temperature of the boilers with bad effects on the fire-box and flues.

The covering of stacks on locomotives when fires are knocked out should receive more attention, as locomotives with stacks covered retain steam pressure from five to seven hours longer than when they are left uncovered and air is allowed to circulate through the flues. It also prevents the flues from sweating, which often causes engine delays.

The front end inspection of locomotives through the smoke box door should be extended to making inspection through the smoke stack. Many locomotives are in service today with petticoat pipes out of line or hangers and bolts loose, table plates loose, and with holes in them, blower pipe out of line, air pump exhaust pipe out of line, exhaust tips gummed or loose or with bridges in them. Experience has taught that just opening the front door and making an inspection from that point has not given the desired results. Periodical inspections of front ends for air leaks should also be put into effect.

A great many of the older locomotives are running today with draft sheets set so close to the tubes that gases strike them with such force as to stop the flow through other tubes, thus causing excessive heat at the fire door. All draft sheets should be set far enough away from the flue sheet so that the gas, after reaching the end of the flues may travel freely to the atmosphere.

The uniform drafting of locomotives should receive the necessary consideration, in order that the benefits resulting from the proper sizing of coal and the proper handling of it by engineers and firemen may be secured. Records show that firemen who do well on certain locomotives are absolute failures on other engines of the same class, on account of the variation of exhaust tips and other front end irregularities. Often times poor performance is secured where competent firemen are doing their best. Some railroads have already adopted uniform nozzle openings. A record should be kept showing the size of the nozzle opening in every engine and every change in the size of the nozzle should be recorded. A reduction of 1/8 in. in the diameter of the nozzle will waste one ton of coal over an average division.

The saving of coal and the increased efficiency to be produced by testing superheater units at regular intervals of 30 days will no doubt more than offset the expense of examination. Superheater units leaking can waste large quantities of fuel though the locomotive may perform apparently satisfactory service. All flues should be thoroughly cleaned. Many times this work is apparently done, but a closer investigation develops that the tubes are given a "lick and a promise" cleaning only. When flue cleaning is done in this manner, engines will not steam freely and will be wasteful of coal. Such a condition will not exist if there is a capable inspector around.

Much emphasis must be laid on the necessity of keeping boilers clean and free from scale. Tests indicate that 1/16 in. of scale will increase the fuel cost 15 per cent. Good feed water is not always obtainable, but for the sake of economy railroads can well afford to spend money for purifying plants, or any practical means of treating water in tender tanks or locomotive boilers. With any of these treatments, regular and good boiler washing is of vital importance. The inspection of boilers after being washed out is very important. Fuel and labor saving devices must always be kept in best of condition; failure to do so will result in vast waste of fuel. Representatives of the manufacturers should be called on when devices are not giving proper results.

Steam heat pipes on locomotives should be covered from the source of supply in the cab to the rear of the tender. Many locomotives are in service today with 45 ft. of steam heat pipe uncovered and the connection between the engine and tender so low as to be dragging in the snow. In some cases the tender leaks and the drippings fall on the steam heat pipes, condensing the steam in addition to the loss by radiation. Consider how much condensation this 45 ft. of exposed pipe will create on a locomotive on a cold, stormy day, fanned by the winds. The loss does not stop here; in severe weather, on long passenger trains, steam traps and pipes become frozen, due to excessive condensation and it becomes necessary to delay passenger trains to thaw the pipes and again get steam through the train. These delayed passenger trains delay other trains on the road. The steam pipe to the air pump should be placed under the locomotive jacket and all other locomotive steam pipes exposed to the weather should be covered.

Every pound of unconsumed coal that finds its way to the ash pit is a direct loss. Supervisors of fuel can procure good results by meeting engines on arrival at the cinder pit and making clear to the enginemen and firemen the amount of fuel lost by not keeping fires in proper condition.

Close attention must be given to the fuel used at stationary power or heating plants, at terminals, roundhouses, pumping stations, and elsewhere. A large share of fuel is used at these places and frequently wastefully used. A large loss of fuel is sustained due to exposed steam surfaces; in many places steam pipes are laid in or on the ground without any protection from the weather, causing wasteful condensation. When conduits are not available these lines should be located overhead and covered. Cover all steam pipes, connections, boilers and manifolds, and stop all air leaks in boiler settings. There should be a more general use of CO_2 recording apparatus and draft gages in connection with the investigation of fuel conditions in power plants. Efforts here will yield a large return.

Compressed air is the most expensive power to produce that is used for railroad shop and yard service. All air lines leading from compressors should be so arranged that each department can be cut out when working hours cease, or when it is no longer required. Fuel bulletin boards should be established at all district terminals. These boards should be used exclusively for fuel bulletins, circulars and graphic statements. Railroads that publish employees' magazines should see that each publication gives some space to the subject of fuel conservation. Coal gates and coal chutes should be stenciled, "Save Fuel," also other places where coal is handled or used. If every railroad man will but realize his personal responsibility to do his utmost under existing conditions, and if he will in his daily work steadily apply the good practices with which he is familiar, avoiding the poor practices and encouraging others to do likewise, enormous savings in fuel will result.

REMOVE SOOT BY BURNING SALT

Joseph Harrington, administrative engineer, United States Fuel Administration, at Chicago, describes a method for removing soot from the furnace walls and heating surfaces which was called to his attention by C. J. Causland, electrical engineer of the Pennsylvania at Chicago, and Jerome Kohout, chief chemist of the Commercial Testing & Engineering Company, Chicago. He says:

"One of the most difficult problems which conservation engineers in the State of Illinois encounter in the burning of local coal in both steam boilers and house-heating furnaces, is the removal of the excessive deposit of soot and tarry substances on the cold heating surfaces of the boilers. This tar or soot has an insulating value far in excess of any commercial insulator. One 1/32 in. of soot on a boiler reduces the transmission of heat approximately 10 per cent, and 20 per cent for 1/16 in. In view of the well known fact that heating surfaces quickly become covered with soot as thick as the foregoing, the great importance of some method of removing it becomes apparent.

"This process is in brief, the application of common salt to the fire under conditions which will produce dissociation of the sodium and chlorine from the salt and the subsequent combination of these elements with the carbon of the soot to form a substance which then passes off as a gas or drops off of the heating surface. The practice is briefly as follows:

"The fire is put into good condition with a substantial body of hot fuel. Common salt, previously dried, is then thrown or sprinkled onto the incandescent fuel bed in a quantity depending entirely on the size of the furnace. In the case of a household furnace a pound at a time is ample, in the case of a large power plant boiler, four or five scoopfuls may be required. The dampers are kept open so as to maintain the furnace temperature and the salt is allowed to remain until the fumes have entirely disappeared.

"Immediately upon charging the salt, the furnace becomes filled with dense white fumes which may require as much as half an hour to entirely disappear. If results are not secured on the first application, it should be repeated as many times as necessary. Once the heating surface is thoroughly cleaned, a small application every few days is usually sufficient to keep it so."

U. S. R. A. Mechanical Department

Abstract of Mr. McAdoo's Report to the President of the Work and Accomplishments of This Section

On February 9, 1918, Frank McManamy, chief inspector of locomotives for the Interstate Commerce Commission, was appointed manager of the Locomotive Repair Section of the United States Railroad Administration. On July 1, 1918, he was promoted to assistant director of operation, in charge of the mechanical department and his jurisdiction extended to include car repairs, supervision of mechanical standards, and of tests of new devices. Later he was given jurisdiction over the enforcement of federal laws for the promotion of safety for employees.

Methods Adopted for Improving Equipment.—On account of the competition of high wages paid by the shipbuilding plants and war industries generally there was a considerable shortage of skilled mechanical workers in railroad shops. Immediate relief could only be secured by working a greater number of hours. Railroad shops on many of the important lines were placed on a basis of 70 hours per week, and the remainder on 60 hours per week, which was approximately an average increase of 20 per cent in shop hours. In June all shops were placed on the 60-hour-per-week basis, which continued until the signing of the armistice, when arrangements were made for readjusting the hours, which were reduced on November 25 to nine, and December 9 to eight hours per day.

Co-ordination of Locomotive Repairs.—A check of the repair shops indicated that their combined capacity was ample to take care of all of the locomotives if they were properly distributed. Plans were immediately perfected to send locomotives to the nearest available repair shop, regardless of ownership, and to distribute the work so that each shop could be worked to capacity. Under this plan, since January 1, we have transferred 2,065 locomotives to the shops of other railroads under federal control, where they had been given heavy classified repairs; otherwise, these locomotives could not have been kept in service.

Comparison of Motive-Power Conditions.—Accurate comparison of motive-power conditions with one year ago is difficult, because of the varying methods of rendering reports prevalent on the different lines. The improvement in the condition of locomotives is perhaps best indicated by the fact that, notwithstanding the tonnage handled during the year has been the heaviest ever known, there are now stored in good condition and ready for winter service, 1,189 locomotives, while one year ago there was not a single serviceable locomotive in storage. This improved condition is due to the co-ordination of shopwork.

Condition of Freight Cars.—The general condition of freight cars has also shown a substantial improvement since the organization of the mechanical department. The percentage of bad-order cars to revenue cars on line has decreased from 7 per cent in July to 5.3 per cent, which is a decrease of approximately 43,000 in the number of bad-order cars.

GENERAL CONDITION OF EQUIPMENT AND TERMINAL FACILITIES

One of the prime causes for the necessity of government control of railroads and one of the most serious conditions the Railroad Administration was called on to correct when assuming control, was the general bad condition of locomotives and cars. As the Railroad Administration had at that time no mechanical department organized to check up shop practices and handling of equipment at terminals, the Interstate Commerce Commission promptly placed at the disposal of the Railroad Administration the records and personnel of its Bureau of Locomotive Inspection and Bureau of Safety.

The reports showed that in addition to the congestion caused by failure of shippers to unload cars promptly that a serious situation existed on account of the number of bad-order cars at various terminals and also on account of the general defective, run-down condition of motive power.

Prompt handling of locomotives was seriously hampered by the condition of roundhouses and the lack of facilities at many points to make running repairs to large modern locomotives. Roundhouses built 20 or more years ago for locomotives in service at that time were still being used to house locomotives more than twice the size for which they were designed. Repairs had to be made either out of doors or in open roundhouses with the temperature below zero. Steam pipes, injectors, air pumps, and even cylinders froze and burst, and in many cases locomotives were actually frozen to the track in roundhouses and could not be moved.

Only two methods for improving the general condition of equipment existed; namely, to increase the shop facilities and forces or to use more efficiently the facilities and forces which were available. Increasing the facilities and forces under war conditions was clearly impossible; this left as the only practical means of improving equipment conditions the adoption of some plan whereby existing facilities and forces could be made to produce greater results.

The plan of considering the condition of equipment as a whole and taking steps to improve it by uniformly increasing shop hours on all railroads in the country and utilizing to their full capacity the facilities of all shops which could only be done under federal control is really what improved the condition of the locomotives and cars.

STANDARDIZATION OF EQUIPMENT

The standardization of locomotives and cars is an ideal which has long been striven for by the various organizations of railroad officials, and much has been done by them to bring about this result. Complete accomplishment has never heretofore been possible because of an absence of authority to enforce standards which might be agreed upon. This has now been accomplished by the preparation and adoption of standard designs for different types of locomotives which are suitable for all classes of service and by standardization of freight and passenger equipment.

Standardized Locomotives.—In addition to the vigorous action which had been taken to improve the condition of existing equipment, the necessity of adding to the available stock was recognized and designs were worked out for standardized locomotives and orders placed for their construction.

The locomotives were built from standardized designs for various reasons, the principal of which are as follows:

First. To reduce to a minimum the time required to prepare drawings, patterns, and dies, and thus enable deliveries to begin quicker than where separate drawings and patterns would have been necessary for each lot of locomotives allocated to a particular road.

Second. To secure quantity deliveries.

This method of construction has resulted in delivery being made at a quantity rate which could not have been approached had the locomotives been ordered to individual designs. The increase in the rate at which standardized locomotives can be turned out is clearly shown by the following comparison of two of the principal shops of the American Locomotive Company during a portion of July and August when the locomotives built were of individual design with a similar period in September and October when they were building standardized locomotives. During five weeks, beginning July 20, an average of 13⅗ locomotives per week were turned out at the Dunkirk plant, while during five weeks, beginning September 14, an average of 19⅘ locomotives per week were turned out at the same plant. For Schenectady, during the five-week period beginning July 20, an average of 8 locomotives per week were turned out, while for the corresponding period beginning September 14 an average of 13 2-5 locomotives were turned out. It will be seen that the increased production due to the standardized locomotives was about 50 per cent.

Third. It has also provided a supply of equipment, the parts of which are largely interchangeable, which is available for use anywhere in the event of congestion. This removes the necessity of carrying a large stock of repair parts peculiar to the locomotive and avoids delay which results when repair parts must be ordered from some distant owning road.

Standardized Cars.—The freight car situation was handled along the same lines as were the locomotives. In addition to the designs for freight cars, for which orders have been placed, designs have been prepared for all-steel box cars of 50 tons capacity, refrigerator cars of 30 tons capacity, general service gondola cars of 50 tons capacity, steel frame stock cars of 40 tons capacity, flat cars of 55 tons capacity, oil tank cars of 7,000 gal. capacity, oil tank cars of 8,000 gal. capacity, oil tank cars of 10,000 gal. capacity, acid tank cars of 7,000 gal. capacity, acid tank cars of 8,000 gal. capacity, and acid tank cars of 10,000 gal. capacity. While no cars have actually been built from these drawings, they are available at any time that the traffic needs show them to be desirable.

Complete plans and specifications of all steel baggage cars, in both of 60-ft. and 70-ft. lengths, have been prepared, and tentative plans prepared for 70-ft. steel coaches, and for steel passenger and mail, passenger and baggage, passenger, baggage and mail cars.

STANDARD PRACTICES

Standard practices have been established and circulars of instruction issued for mechanical work covering the following matter, which will result in more efficient and economical operation of locomotives and cars: Repairs and betterments to freight cars, painting freight cars, installing field ranges in cars, locomotive maintenance, care of journal boxes, inspection of ash pans and spark arresters, lubrication of locomotives, repairs to refrigerator cars, and superheating of locomotives.

Rules have also been promulgated for the inspection and testing by the inspection forces of the railroad companies of all stationary boilers used, which will make it possible to save the insurance premiums now paid on such boilers.

CONSOLIDATION OF MECHANICAL TERMINAL FACILITIES

Under private operation, at many points complete organizations for the maintenance of a comparatively small number of locomotives or cars were maintained side by side, which resulted in a duplication of work, heating plants, and supervising forces. Wherever a saving could be made without adversely affecting efficiency, such useless facilities were eliminated. Such consolidations have been made at 417 points and the annual saving effected thereby amounts to $2,363,535.95. Additional consolidations are now under way.

In connection with this work extensive investigations were conducted covering shop and engine-house operation, resulting in changes and improvements which have materially increased the output. For example, at one large shop the output of locomotives receiving classified repairs increased over 50 per cent, and increases ranging from 10 to 25 per cent were secured in many shops. It was also possible by rearranging the method of handling work in engine houses to release hundreds of employees that were sorely needed in other departments, and the saving effected in engine-house operation by such reduction in force, while not obtainable for all railroads, on one railroad alone amounted to $1,061,332.68 per annum.

The condition of motive power on all lines under federal control has shown a gradual improvement, and the locomotives in service are in much better condition than they were one year ago. In addition to the improved condition of power in service there are now in white lead 1,021 locomotives in the various regions. These locomotives have received classified repairs and are being held in reserve for winter service. There are also being placed in storage for service during the winter months 150 new standardized locomotives which were recently received from the locomotive builders.

NEW DEVICES FOR LOCOMOTIVES AND CARS

On account of the vast number of new devices for use on locomotives and cars which were submitted, a comprehensive plan for handling this question was necessary. Detailed instructions were issued by circular establishing rules for the submission of such devices for the consideration of the Railroad Administration and a committee on appliances was created to conduct necessary investigations and to pass upon the value of all devices or appliances thus submitted. Up to date 692 such devices, which cover practically everything used in locomotive or car construction, have been submitted. One hundred and thirty-five of these have been examined, ten of which have been recommended for test under service conditions. These tests will proceed under the direction of the mechanical department.

EDUCATION OF RAILROAD EMPLOYEES

It has long been recognized that the service rendered by railroad employees is capable of substantial improvement by proper training of employees along industrial lines, and many railroads have in existence plans for furnishing additional training for their employees.

The Railroad Administration is in sympathy with this work and plans are being considered for establishing a system of technical training for railroad employees in connection with the Board of Vocational Education. It is also believed that this work may be profitably extended to employees who have been injured in the service to an extent that prevents them from following their usual vocation, but with proper training may fill other responsible positions.

ORGANIZATION

The work of the mechanical department, Division of Operation, has been conducted with a total force of approximately 60. Of these, 28 are considered as field men whose duties are to conduct investigations concerning shop practices and shop output and to furnish first-hand information relative to the efficiency of the work performed and the general condition of the equipment. They are also used to conduct investigations and handle disputes between shop men and railroad officials which have not reached the point where they should be referred to the Division of Labor.

The office force, in addition to handling ordinary correspondence, receives, checks and compares the reports showing the general condition of equipment, the assignment of locomotives to shops for repairs as well as the assignment of new locomotives received from the builders. It also includes the mechanical engineering staff, which checks up the designs for locomotives and cars, receives reports of failures of standardized locomotives, and corrects faulty construction. The mechanical engineering staff also acts as a clearing house for information concerning standard designs of locomotives and cars, distributes drawings and other data necessary to the proper standardization of equipment and keeps the practices up to the standard.

NEW TYPE OF LOCOMOTIVE FIREBOX

By the Introduction of Thermic Syphons the Evaporating Efficiency of the Boiler Is Materially Increased

THE Chicago, Milwaukee & St. Paul has recently completed a series of road tests of a locomotive equipped with a new type of firebox. The principal feature of the design consists of two water legs extending longitudinally from the throat of the boiler to the crown sheet. The trials were conducted with one locomotive so equipped and another of the same class with a firebox of the usual type. The results showed that the new design caused a noteworthy increase in the boiler efficiency with a corresponding decrease in the fuel consumption. The performance, as developed by the tests, is summarized in the adjoining table. Locomotive 7142 had the ordinary type of boiler, while engine 7615 had the new type of firebox.

The boiler tests conducted at Coatesville in 1912 proved conclusively that the water evaporated per square foot of heating surface in a locomotive boiler is much greater in the firebox than in the boiler tubes and flues. The maximum evaporation per square foot of tube heating surface is estimated at about 10 lb. per hr., while the corresponding figure for the firebox is 55 lb. per hr. Since these important facts have been demonstrated, the tendency in boiler design has been along the line of increased firebox heating surface. It is a difficult matter to secure more than a very limited increase in the area of the sheets in the usual design of firebox. To overcome this difficulty J. L. Nicholson of the Locomotive Firebox Company, Chicago, recently patented a new design of firebox. The salient features of this design are the water legs in the firebox, known as Nicholson Thermic Syphons.

The syphon is formed from a single sheet rolled to shape and closed by welding along the front edge. The sides are set four inches apart and joined to the crown sheet, extending from a point about 18 in. from the front edge to about 6 in. from the rear. The front edge of the water leg is parallel to the tube sheet; from the back of the crown sheet it slopes downward toward the throat of the boiler. The cross section of the leg is increased at the lower edge to form a segment of a circle six inches in diameter, which joins a 6-in. tube extending into the lower portion of the tube sheet. The syphons thus form a support for the sectional brick arch. Fig. 1 shows the side elevation and plan of the firebox on which the

GENERAL RESULTS OF TESTS

	Engine 7142	Engine 7615	Decrease, Engine 7615 Per cent
Pounds coal fired per thousand gross ton miles, actual	124.36	93.64	24.7
Pounds coal fired per thousand gross ton miles, equated	124.36	86.63	30.3
Pounds coal fired per locomotive mile	271.9	218.9	19.4
Average tonnage hauled	2,190.0	2,340.0	6.8*
Pounds of water used per thousand gross ton miles	670.72	596.22	11.1
Pounds water evaporated per pound of coal fired	5.39	6.36	18.0*
Equivalent evaporation per pound of coal fired	6.54	7.74	18.3*
Equivalent evaporation per pound of dry coal	7.28	8.60	18.1*
Equivalent evaporation per pound of combustible	8.37	10.49	25.3*
Boiler efficiency	57.65	73.75	27.92*
Front-end temperature	625 deg. F.	550 deg. F.	13.6

* Increase.

tests were made, equipped with the syphons. Fig. 2 shows another method of installing thermic syphons in locomotive fireboxes. In this case, instead of flanging the neck of the syphon out and welding it into the throat sheet, a separate diaphragm plate is used, the syphon being formed with a separate neck and expanded into the diaphragm plate, also being riveted and welded as shown. This is for the purpose of giving more flexibility to the installation, and also to enable the manufacturers, by eliminating the flanged portion of the neck and making the neck long enough to fit extreme cases, to standardize the manufacturing forms and dies.

Test Conditions and Methods

The test runs were conducted between Milwaukee and Portage, Wis. The distance westbound was 91.8 miles and eastbound 89.1 miles. There was no attempt to control the makeup of the test trains. The tonnage was limited to what the engines could handle on the ruling grade, and trains were run as extras with whatever cars were available. Two trips eastbound and two westbound were made with each locomotive, the same engine crew being used on all the tests. A road foreman of engines acted as cab observer and all other readings were taken by employees of the test department un-

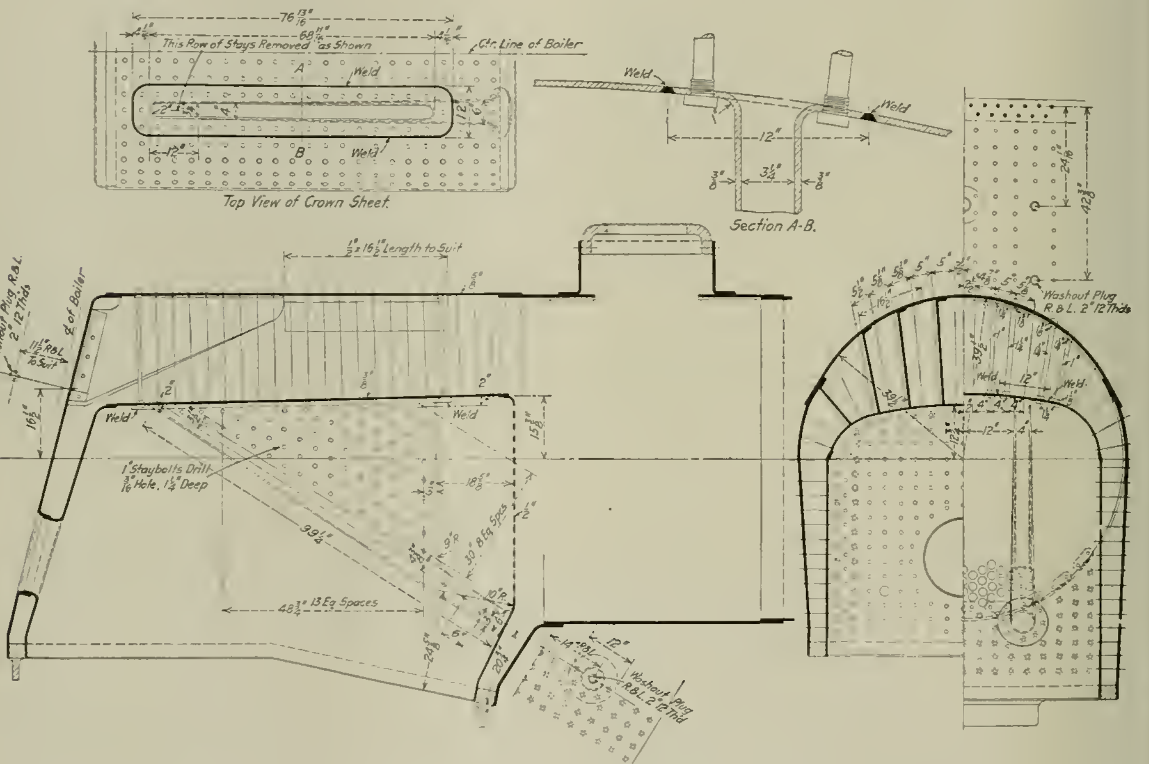


Fig. 1—Firebox of Chicago, Milwaukee & St. Paul Locomotive Equipped with Nicholson Thermic Syphons

The locomotives tested were of the Consolidation type, using saturated steam and equipped with piston valves and Walschaert valve gear. They were alike in all respects except that the firebox of locomotive 7615 was equipped with the Nicholson Thermic Syphons supporting the brick arch, while 7142 had a brick arch supported on four 3-in. arch tubes. Both had recently received heavy repairs.

Locomotive Data

	Engine 7615	Engine 7142
Cylinder diameter and stroke	23 in. by 30 in.	23 in. by. 30 in.
Diameter of drivers	63 in.	63 in.
Tractive effort	42,800 lb.	42,800 lb.
Weight on drivers	190,400 lb.	189,200 lb.
Total weight of engine	216,900 lb.	215,700 lb.
Total weight of engine and tender	351,450 lb.	350,250 lb.
Boiler type	Straight. radial stay	Straight. radial stay
Boiler diameter, first course	75¼ in.	75¼ in.
Grate area	48.8 sq. ft.	48.8 sq. ft.
Tubes, number and outside diameter	414—2 in.	418—2 in.
Tube heating surface	3,143.0 sq. ft.	3,173.4 sq. ft.
Normal firebox heating surface	195.7 sq. ft.	195.7 sq. ft.
Heating surface added by arch tubes	....	29.3 sq. ft.
Heating surface added by thermic syphons	53.0 sq. ft.	....
Total firebox heating surface	248.7 sq. ft.	225.0 sq. ft.
Total heating surface	3,391.7 sq. ft.	3,398.4 sq. ft.
Total heating surface ÷ grate area	69.5	69.6
Firebox heating surface ÷ total heating surface, per cent	7 3	6.6
Firebox heating surface ÷ grate area	5.1	4.6

der the direction of G. P. Kempf, engineer of tests. Weather conditions were uniform throughout the tests.

Train Make-Up, Tonnage and Time.

Eng. No.	Test No.	Cars hauled over ruling grade	Tonnage over ruling grade	Adjusted tonnage	Gross ton-miles	Time over division, hr. min.	Time in motion, hr. min.
7615	1-E	49 lds. 5 empt.	2565	2565	228,285	6 54	5 38
	2-W	29 lds. 1 empt.	2027	2166	198,853	6 59	5 14
	3-W	32 lds. 1 empt.	2055	2237	205,410	7 46	5 54
	4-E	34 lds. 35 empt.	2392	2391	212,900	6 17	5 12
	Ave.	36 lds. 10 empt.	2260	2340	211,362	6 59	5 30
7142	1-W	35 lds. 31 empt.	1976	1976	181,400	8 27	6 27
	2-E.	47 lds. 7 empt.	2315	2294	204,200	6 38	5 8
	3-W	45 lds. 0 empt.	2006	1990	182,700	7 13	5 39
	4-E	51 lds. 0 empt.	2499	2499	222,400	5 45	5 5
	Ave.	44 lds. 9 empt.	2199	2190	197,675	7 1	5 35

The engines were coaled at the chutes, no attempt being made to select the coal. The amount used was obtained by weighing the tender at the end of each run with all water emptied out of the tank. Sacked coal was used while at terminals and standing or switching on the road.

Samples were taken from the tender during each trip and were later analyzed. The average analysis was as follows:

Analysis of Coal as Fired

Eng. No.	Moisture	Volatile combustible	Fixed carbon	Ash	B. t. u. per pound coal
7615	10.00	35.02	38.75	16.23	10,184
7142	10.21	37.36	40.80	11.63	11,008

The coal consumption and firing rate are shown below:

Coal Consumption

Eng. No.	Test No.	Total lb. coal fired	Average lb. coal fired per hr.	Lb. coal per hr. per sq. ft. of grate	Lb. coal fired per 100-car mile	Lb. coal fired per locomotive mile	Lb. coal fired per gross 1,000 ton-miles
7615	1-E	18,400	3,262	66.84	382.8	206.7	80.60
	2-W	20,450	3,903	80.00	689.0	222.7	102.84
	3-W	20,820	3,523	72.19	513.7	226.8	101.35
	4-E	19,505	3,744	76.72	317.6	219.1	91.61
	Ave.	19,794	3,599	73.75	440.6	218.9	93.64
7142	1-W	29,450	4,558	93.40	486.0	320.8	162.12
	2-E	22,100	4,300	88.11	483.9	248.3	108.22
	3-W	25,855	4,568	93.60	638.1	281.6	141.51
	4-E	20,930	4,120	84.42	461.1	235.1	94.10
	Ave.	24,584	4,401	90.18	510.8	271.9	124.36

From an operating standpoint the boiler performance of both locomotives was satisfactory, although it was noticeable

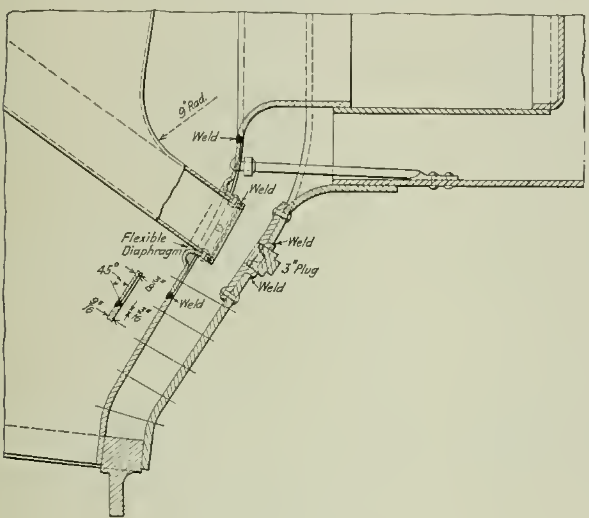


Fig. 2—An Improved Method of Applying the Thermic Syphon to the Throat

that the boiler of engine 7615 was more responsive to the demands made upon it than that of engine 7142.

It will be noted that the average boiler horsepower developed by locomotive 7615 was 807.4, as compared with 834.8 horsepower for engine 7142. This is to be accounted for by the fact that engine 7142 consumed 12.4 per cent more water per thousand gross ton miles. Neither of the locomotives was forced to the limit of the capacity of the boiler. Engine 7615 developed a maximum boiler horsepower of 1,015 on the grade from Milwaukee to Brookfield. This is at the rate of 10.62 lb. equivalent evaporation per square foot of heating surface per hour.

Both locomotives had double exhaust nozzles with 3½-in. tips at the time these readings were taken. On the last round trip with engine 7615 the tips were enlarged to 3-11/16 in. diameter, which reduced the vacuum somewhat. The front end temperatures were obtained by means of a Hoskins pyrometer. It is thought that owing to an improper adjustment of the recorder the temperatures recorded for engine 7142 are too low.

No analysis was made of the front end gases, so it is impossible to tell exactly what changes in combustion conditions were brought about by the changes in the firebox. The reduction in the coal consumption, the increase in the evaporation and the marked absence of smoke indicates that the syphons tend to improve combustion conditions by breaking up the stream of gases and securing a better mixture of the combustible gases and the air.

In considering the increased boiler efficiency secured by the use of the Nicholson Thermic Syphons it should be noted that engine 7615 was working at a lower rate of evaporation

Boiler Performance—Coal and Apparent Evaporation

Eng. No.	Test No.	Lb. coal fired per bour	Lb. water evap'd per hour	Lb. water evap'd per lb. coal	Lb. water evap'd per sq. ft. heat. surf.	Temp. feed water	Average boiler pressure	Factor of evap.
7615	1-E	3,262	21,782	6.68	6.42	49 Deg.	198.3	1.2187
	2-W	3,903	23,553	6.04	6.94	52 Deg.	199.2	1.2149
	3-W	3,523	22.825	6.48	6.73	52 Deg.	198.9	1.2149
	4-E	3,744	23,589	6.30	6.95	51 Deg.	198.4	1.2159
	Ave.	3,599	22,912	6.36	6.75	51 Deg.	198.7	1.2159
7142	1-W	4,558	23,707	5.20	6.97	50 Deg.	198.8	1.2170
	2-E	4,300	24,554	5.71	7.22	54 Deg.	198.3	1.2129
	3-W	4,568	23,394	5.12	6.88	58 Deg.	196.6	1.2086
	4-E	4,120	23,338	5.66	6.88	52 Deg.	197.6	1.2149
	Ave.	4,401	23,728	5.39	6.98	53 Deg.	197.9	1.2139

Boiler Performance—Equiv. Evap. Horse Power and Efficiency

Equivalent-evaporation—from and at 212 Deg. F. lb.

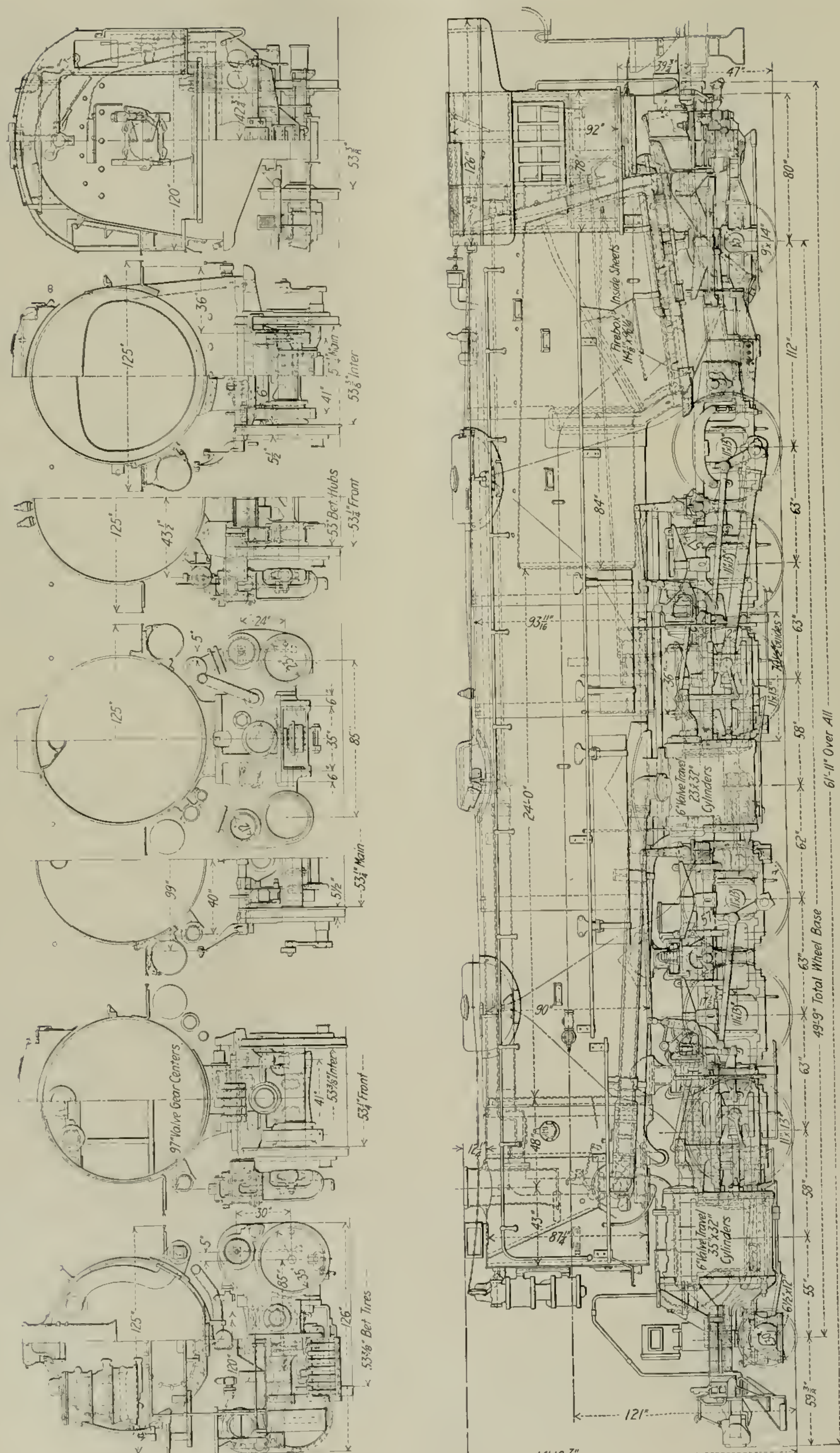
Eng. No.	Test No.	Per hour	Per hr. per sq. ft. heat. surf.	Per lb. of coal as fired	Per lb. of dry coal	Per lb. of combustible	Boiler hp.	Boiler efficiency
7615	1-E	26,546	7.82	8.14	9.04	9.42	769.4	67.00
	2-W	28,615	8.43	7.34	8.14	10.22	826.5	73.63
	3-W	27,730	8.16	7.87	8.74	11.09	803.7	77.96
	4-E	28,682	8.45	7.66	8.51	10.77	831.3	77.26
	Ave.	27,858	8.21	7.74	8.60	10.49	807.4	73.75
7142	1-W	28,851	8.48	6.33	7.10	8.26	836.2	58.00
	2-E	29,781	8.76	6.93	7.35	8.95	863.2	61.35
	3-W	28,274	8.31	6.19	6.96	7.85	819.5	53.89
	4-E	28,353	8.34	6.88	7.59	8.56	821.8	58.10
	Ave.	28,803	8.47	6.54	7.28	8.37	834.8	57.65

Draft and Front End Temperature

Eng. No.	Test No.	Lb. coal fired per hour	Lb. coal fired per sq. ft. grate per hour	Draft—Inches of water: Front end	Firebox	Ash pan	Front end Temp. Deg.
7615	1-E	3,262	66.84	5.2	1.67	.27	520
	2-W	3,903	80.00	5.3	1.66	.29	536
	Ave.	3,582	73.42	5.25	1.66	.28	528
7142	1-W	4,558	93.40	5.3	1.56	.22	610
	2-E	4,300	88.11	5.0	1.27	.17	589
	Ave.	4,429	90.15	5.15	1.41	.195	599

than engine 7142 and also at a lower rate of combustion, which made a favorable condition for obtaining bigher boiler efficiency. In this connection, however, it should not be overlooked that this was not due to operating conditions favoring engine 7615, as the average tonnage hauled by this locomotive was 6.8 per cent greater than that hauled by engine 7142. Making due allowance for the favorable evaporation and combustion rates, there remains a gain in economy which cannot be attributed entirely to the increased firebox heating surface. There is evidently a further saving due to the increase in the radiating surface in the firebox, to the more intimate mingling of the combustible gases with air in the firebox and to the more rapid circulation through the boiler. It is estimated that the rate of flow through the syphons is so fast that all the water in the boiler passes through them every five minutes. Such rapid circulation will cause the water to remain at more nearly uniform temperature throughout the boiler. This should result in a decrease in the boiler troubles due to unequal expansion and contraction.

The cost of application of the Nicholson Thermic Syphons is low, and it is anticipated that the maintenance charges will be negligible compared with the savings effected. The syphon requires no more attention than any other part of the firebox and when properly applied is practically fool-proof and accident-proof. The first installation has been in service for four months and has given no trouble from mud or scale. The rapid circulation has kept the syphons clean and has apparently resulted in throwing the mud and scale into the back water leg, where it can easily be removed. Up to the present time there has been no evidence of scale in the syphons, and no leak or trouble of any nature has developed at the seams or stays. The C. M. & St. P. is now planning to install the syphons on several additional locomotives.



Elevation and Sections of the United States Railroad Administration Standard 2-6-6-2 Type Locomotive

Standard 2-6-6-2 Type Locomotive

**Weights: Total 448,000 lb., Drivers 358,000 lb.;
Tractive Effort Compound 80,000 lb., Simple 96,000 lb.**

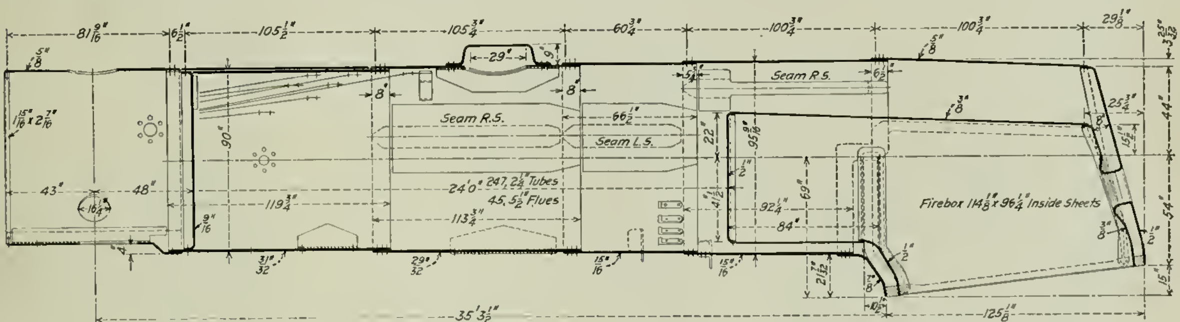
The first of the standard Mallet type locomotives designed by the United States Railroad Administration has recently been turned out by the Schenectady works of the American Locomotive Company, for delivery to the Chesapeake & Ohio. The locomotive is of the 2-6-6-2 type, the lighter of the two standard Mallet types, and orders were placed for 30 of these locomotives.

The locomotive has a weight on drivers of 358,000 lb., 2,000 lb. less than the maximum permissible within the axle load limit of 60,000 lb. The cylinders are 23 in. and 35 in. in diameter by 32 in. stroke and the locomotive is designed to deliver a tractive effort of 96,000 lb. simple and 80,000 lb. compound. In the table will be found a comparison of the principal dimensions and data for a number of Mallet locomotives of the 2-6-6-2 wheel arrangement, of which the standard locomotive is the heaviest both on drivers and in total weight.

The boiler has an outside diameter at the first ring of 90 in., increasing to 95 9/16 in. at the fourth ring just forward of the firebox. The dome is located on the second ring from the front and is 9 in. high.

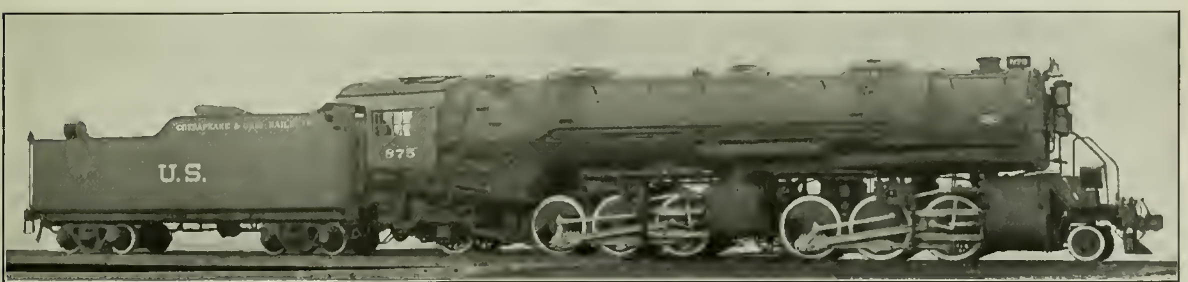
The firebox has a combustion chamber extending forward into the barrel of the boiler 84 in. from the throat sheet, making the tubes 24 ft. long. It is fitted with a Security brick arch carried on five arch tubes and is fired by a Standard stoker. The fire door is of the Shoemaker power operated type and the grates are operated by Franklin power grate shakers. The boiler is fitted with the Locomotive Superheater Company's Type A superheater with 45 units.

In general the detail design of the frames follows that of all the other standard type locomotives which have been built. The top rails for both high and low pressure units are 6 in. wide, with a maximum thickness of 5 in. over the pedestals and a minimum thickness of 4½ in. The lower rails have a maximum and minimum thickness of 3½ in. and 3 in. respectively. The high pressure frames are designed with splice joints at the rear for attachment to a Commonwealth frame cradle which includes in one casting the frames, rear deck plate and trailer equalizer fulcrums. The high pressure cylinders are supported on a single front rail which is cast integral with the main frames.



Boiler for the Standard 2-6-6-2 Type Locomotive

The low pressure frames are designed to receive the articulation joint, which is of the Baldwin universal type, hinged for movement about a horizontal axis transverse to the center line of the locomotive and provided with a ball joint pin connection at the high pressure unit end. The low pressure cylinders are supported by double rails, both of which are bolted to the main frame. The frames of both units are spaced 41 in. from center to center, while the cylinders have a spread of 85 in. Owing to the size of the low pressure cylinders the face of the lower rail bolting flange is only 20½ in. from the center line of the locomotive, thus requiring an offset in the front frame rail. This is provided by bolting the front rail to the inside face of the lower rail extension of the main frame and reducing the lateral thickness of this section to 3 in. where it is joined under the cylinder to the front rail. The section of the extension under the cylinders is 11 in. deep, while that of the front rail has a vertical thickness of 7 in. The upper front rail is bolted and keyed to the top of the main frame over the front pedestal. The section of the main frame here is 13 in. deep with horizontal slots for the splice bolt nuts over the pedestal.



The Railroad Administration Standard 2-6-6-2 Type Locomotive

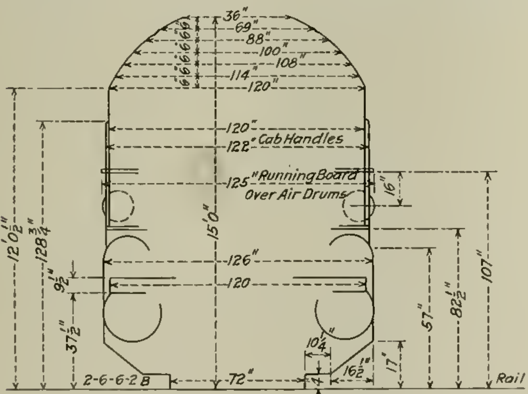
The cylinders and valve chambers throughout are bushed with Hunt-Spiller gun iron. In the design of the high pressure cylinders is incorporated the Mellin intercepting valve which completely controls the admission of steam, either exhaust from the high pressure cylinders or steam direct from the boiler, to the low pressure receiver pipe. Piston valves

COMPARISON OF RECENT MALLET LOCOMOTIVES OF THE 2-6-6-2 TYPE

Name of road	U.S. Std.	B.R. & P.	N. & W.	C. & O.
Year built	1919	1914	1912	1911
Builder	American	American	American	American
Tractive effort, lb.	80,000	80,000	72,800	72,800
Total weight, lb.	448,000	429,000	405,000	400,000
Weight on drivers, lb.	358,000	355,000	337,000	337,500
Diameter drivers, in.	57	57	56	56
Cylinder diameter and stroke, in.	23 & 35 x 32	23½ & 37 x 32	22 & 35 x 32	22 & 35 x 32
Steam pressure, lb. per sq. in.	225	200	200	200
Heating surface, total evap., sq. ft.	5,443	4,935	5,003	5,064
Heating surface, equivalent,* sq. ft.	7,381	6,473	6,485	6,430
Grate area, sq. ft.	76.3	72.2	72.2	72.2
Tractive effort × dia. drivers ÷ equivalent heating surface*	617.8	704.5	628.6	634.0
Firebox heating surface ÷ equivalent heating surface,* per cent	5.6	6.0	5.3	6.1

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

are employed with both the high and low pressure cylinders. These valves are 12 in. in diameter and have a maximum travel of 6 in. The valves for the low pressure cylinders are



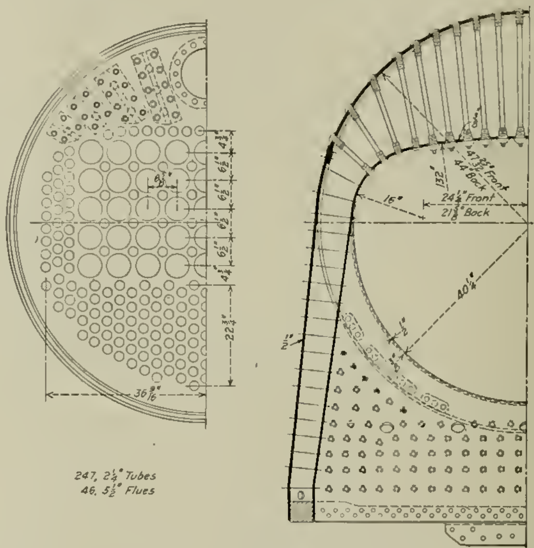
Clearance Diagram for the Standard 2-6-6-2 Type Locomotive

double ported while those for the high pressure cylinders are the same as are used on the 0-6-0 type switchers.

The high pressure piston specifications call for either rolled or cast steel of dished section, while for the low pressure pistons the center of which has a diameter of 30¾ in., exclusive of the bull ring, cast steel only is specified. Hunt-Spiller gun iron bull rings and packing rings are used

distribution is controlled by the Baker valve gear and the Chambers back head type throttle. The locomotive is fitted with a Lewis power reverse gear.

The driving journals throughout have a diameter of 11 in. and are 13 in. long. The driving boxes are interchangeable on all journals, except that the crown brass for the main journals is finished with a clearance of 1/100 in. instead of 1/32 in. The same driving box is also used on the heavy Mountain type locomotive, with the exception of the main journals, and on the main journals of the

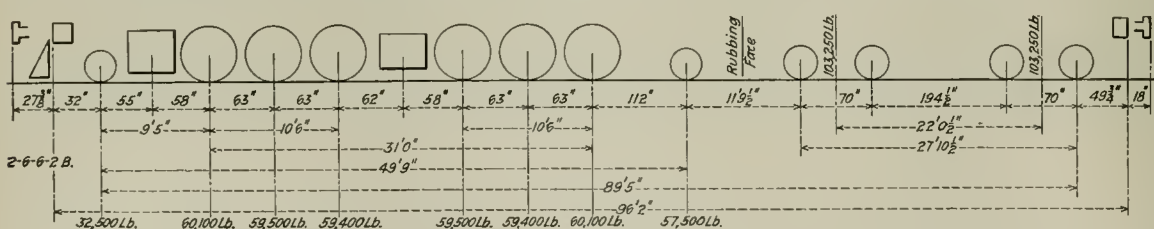


Tube Layout and Firebox Section—Standard Light Mallet Type Locomotive

light Mikado type locomotive. The engine truck is of the constant resistance type and the trailer truck is of the Cole-Scoville type.

The tender tank has a water capacity of 12,000 gallons and a coal capacity of 16 tons. It is carried on a Commonwealth cast steel frame, and is one of the three standard types which have been designed to meet the requirements of all of the standard locomotives. The trucks have cast steel side frames and are of a design which is used on all the standard freight locomotives. The Unit Safety drawbar and Radial buffers are used between the engine and tender.

Among the specialties with which these locomotives are equipped are four Coale three-inch open safety valves, No.



Weight Distribution Diagram for the Standard Light Mallet Type Locomotive

on both high and low pressure pistons. The design of the crossheads is the same in detail as that employed on all previously built standard locomotives, and is interchangeable with that on the 0-6-0 switchers. Paxton-Mitchell packing is fitted both on the valve stems and piston rods. Steam

13 Nathan non-lifting injectors, Nathan bull's-eye lubricators, Ashton steam gages, Okadee flanged blow-off cocks and Barco flexible pipe joints.

On the diagrams, prepared by F. P. Pfahler, chief mechanical engineer, Division of Operation of the Railroad Administration, will be found the clearances and actual wheel load distribution for these locomotives. Other dimensions and data are as follows:

General Data

Gage	4 ft., 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort, compound	80,000 lb.
Tractive effort, simple	96,000 lb.
Weight in working order	448,000 lb.
Weight on drivers	358,000 lb.
Weight on leading truck	32,500 lb.
Weight on trailing truck	57,500 lb.
Weight of engine and tender in working order	654,000 lb.
Wheel base, driving	31 ft.
Wheel base, rigid	10 ft. 6 in.
Wheel base, total	49 ft. 9 in.
Wheel base, engine and tender	89 ft. 5 in.

Ratios

Weight on drivers ÷ tractive effort, simple	3.7
Total weight ÷ tractive effort, simple	4.7
Tractive effort, compound × diam. drivers ÷ equivalent heating surface*	617.8
Equivalent heating surface* ÷ grate area	100.3
Firebox heating surface ÷ equivalent heating surface,* per cent	5.6
Weight on drivers ÷ equivalent heating surface*	48.5
Total weight ÷ equivalent heating surface*	60.7
Volume equivalent simple cylinders	21.7 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	340.5
Grate area ÷ vol. cylinders	3.4

Cylinders

Kind	Compound
Diameter and stroke	23 in. and 35 in. by 32 in.

Valves

Kind	Piston
Diameter	12 in.
Greatest travel	6 in.
Outside lap	1 in.
Inside clearance	H. P., ¼ in.; L. P., ⅜ in.
Lead in full gear	⅛ in.

Wheels.

Driving, diameter over tires	57 in.
Driving journals, main, diameter and length	11 in. by 13 in.
Driving journals, others, diameter and length	11 in. by 13 in.
Engine truck wheels, diameter	30 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.
Trailing truck, journals	9 in. by 14 in.

Boiler

Style	Straight top
Working pressure	225 lb. per sq. in.
Outside diameter of first ring	90 in.
Firebox, length and width	114⅛ in. by 96¼ in.
Firebox plates, thickness	Sides, back and crown, ⅜ in.; tube, ½ in.
Firebox, water space	Sides and back, 5 in.; front, 6 in.
Tubes, number and outside diameter	247—2¼ in.
Flues, number and outside diameter	45—5½ in.
Tubes and flues, length	24 ft.
Heating surface, tubes	3,478 sq. ft.
Heating surface, flues	1,549 sq. ft.
Heating surface, firebox and arch tubes	416 sq. ft.
Heating surface, total	5,443 sq. ft.
Superheater heating surface	1,292 sq. ft.
Equivalent heating surface*	7,381 sq. ft.
Grate area	76.3 sq. ft.

Tender

Tank	Water bottom
Frame	Cast steel
Weight	206,500 lb.
Wheels, diameter	33 in.
Water capacity	12,000 gal.
Coal capacity	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

ENGINE FAILURES—CAUSES AND REMEDIES*

It has been said that the engine failure reports form one of the best barometers of the efficiency of the mechanical department, and this is indeed the case where all detentions and reported failures are carefully investigated *before* they are recorded. Where the engine failures charged depend, however, on the reports of conductors or on interpretations of the rules by the despatcher's or trainmaster's clerk, the accuracy of the charge is often open to question.

An engine failure on the line of road is an expensive proposition, more far reaching in its effects on the movement of trains than is generally believed by mechanical men who have had no road experience, often so upsetting the despatcher's pre-arranged schedule that we cannot be surprised if he loses his temper and feels like charging every delay, regardless of cause, as an engine failure.

*Abstract of a committee report presented at the 1918 convention of the Traveling Engineers' Association.

DEFINITION OF WHAT CONSTITUTES AN ENGINE FAILURE

1. All delays waiting for an engine at an initial terminal, except in cases where an engine must be turned and does not arrive in time to be cared for before leaving time.

2. All delays on account of engines breaking down, running hot, not steaming well, or having to reduce tonnage on account of defective engine, making a delay at a terminal, a meeting point, a junction connection, or to other traffic.

DELAYS THAT SHOULD NOT BE CONSIDERED AN ENGINE FAILURE

1. Do not report cases where engines lose time and afterwards regain it without delay to connections or other traffic.

2. In cases where a passenger or scheduled freight train is delayed from other causes, and an engine (having a defect) makes up more time than she loses on her own account, should not be called an engine failure.

3. Do not report delays to passenger trains when they are less than five minutes late at terminals or junction points.

4. Do not report delays to scheduled freight trains when less than 20 minutes late at terminals or junctions.

5. Do not report delays when an engine is given excess of tonnage and stalls on a hill, provided the engine is working and steaming well.

6. Do not report delays on extra dead freight trains if the run is made in less hours than the miles divided by ten.

7. Do not report engine failures on account of engines steaming poorly, or flues leaking, on any run where the engine has been delayed on side-tracks other than by defects of engine, or on the road an unreasonable length of time—say, 15 hr. or more per 100 miles.

8. Do not report an engine failure for reasonable delays in cleaning fires and ash-pans on the road.

9. Do not report failures against engines that are coming from outside points to the shops for repairs.

10. Do not report cases where an engine is held in the roundhouse for needed repairs and called for by the operating department, they being informed that the engine will not be ready until a stated time. Failure to provide that engine before the stated time should not be called an engine failure.

11. Do not report broken draft rigging on engines and tenders caused by air being set on train, account of bursted hose or breaking in two.

12. Do not report delays to fast schedule trains when the weather conditions are such that it is impossible to make the time, provided that the engine is working and steaming well.

13. Do not report delays when an engine gets out of coal and water, caused by being held between coal and water stations an unreasonable length of time.

If rule No. 2 is correctly interpreted there is no need for the 13 qualifying rules. However, if an engine apparently fails on the line of road, it is charged as an engine failure, although the engine may be in perfect condition and the delay due entirely to other causes, such as mishandling on the part of the crew, either engineer or fireman, excessive tonnage, weather conditions, or any of a hundred possible causes, any of which may result in a poor engine performance and for which the engine or its condition is least of all responsible.

The true cause of the poor performance should be determined by a full investigation, which, however, may not be possible immediately and, consequently, when determined several days may have elapsed before the cancellation of the charge is requested. This being the case, it appears to this committee, in justice to the mechanical department, it would be much more equitable were all doubtful cases simply shown as delays on the "morning report" and these delays then promptly investigated and where the failure is established it be so reported on a subsequent report, or else a monthly report compiled, showing all failures and delays.

Any criticism to be of value must be constructive; therefore, as a first step toward the elimination of engine failures, we would recommend a closer relationship between all departments of a railroad, "get-together" meetings about once a month where engine and train performance can be freely discussed and wrong practices corrected.

We would also recommend that the mechanical department be kept advised as far ahead as possible of any power requirements, so that fitting preparation can be made, as where no such system obtains the roundhouse foreman will sometimes take a chance when pressed for power and let an engine go on the assumption that perhaps it can make just one more trip.

A check of the various engine failures extending over a period of two years, shows as follows:

Failures in Two Years Per 1,000 Miles of Road

Air brake and piping	15
Ash pan and rigging	5
Axle, driving, broken	2
Brake rigging	3
Boiler studs	1
Boiler checks	4
Blow-off cocks	3
By-pass valves	2
Cylinder packing	9
Cross-heads	2
Cylinder heads broken	5
Crank pins broken	3
Draft gear	4
Flues leaking	24
Frames broken	7
Follower bolts	1
Foaming	1
Grates and rigging	4
Guides and guide bolts	5
Head lights	6
Hose, air and water	3
Injectors	1
Journals, hot	21
Lubricator	1
Pins, hot	14
Piston rods broken	6
Relief valve	1
Stokers	12
Springs and rigging	6
Tires slipped	31
Terminal delays	39
Valve gear—Stephenson	17
Valve gear—Walschaert	16
Wrist pins and nuts	3
No steam	11
Man failures	13
Total	329

In the list above presented is it not clearly established that if the provisions of the Federal Inspection Laws were fully complied with in letter and spirit at least half of these failures would have been eliminated, and by the same token would it not appear that one of the logical remedies for engine failures is a strict compliance with the inspection rules? An analysis of the above reported failures shows that at least 50 per cent of the mechanical failures should have been preventable and practically all of the man failures likewise.

In this report we will consider only the principal failures, such as are common to all railroads.

Air Brakes and Piping.—An air compressor should be overhauled periodically just the same as a locomotive, but, unfortunately, as the moving parts are hidden and the compressor capacity is usually in excess of average requirements, they are frequently allowed to run until failure results. Some railroads make a practice of numbering air compressors and keeping a mileage record of them, and when the allotted mileage has been made, they are overhauled. The pipes and connections to the air compressor become strained, due to the variations in expansion, the universal use of flexible joints would go far toward preventing pipe failures.

Hot Journals.—Periodical and regular inspection is the logical remedy.

Hot Pins.—The present systems of crank pin lubrication are crude, to say the least. Poor fitting bearings are, of course, responsible for many hot pins, but irregular lubrication is responsible for much more. Heavy grease is a makeshift, not an efficient lubricant.

Cylinder Packing.—With the advent of superheater engines, such failures are becoming more common. Regular periodical inspection, together with the application of a reliable drifting valve, would go far toward reducing this.

Flues Leaking.—This is often due as much to the manner in which the engine is fired, pumped or handled as to any mechanical defect, and much can be done by education and co-operation of the enginemen. Flues should be inspected each trip on arrival and if their condition is such as to make it doubtful if the engine can make a successful trip they should be removed. One road failure will often cost more than the renewal of an entire set of flues.

Broken Rods and Straps.—Rods and rod straps seldom break at once. It would, therefore, appear that closer inspection for cracks would be advisable. It is found that rod, piston, crank pin and axle failures on old locomotives which have been modernized are becoming more frequent, and investigations lead to the belief that some of the failures are due to increasing the tractive effort of the old locomotives without correspondingly increasing the strength of the parts that must stand the increased strain. Fully 80 per cent of the side rods break in the jaws at the knuckle joint connection. This would indicate that our knuckle joints are fitted too snug laterally so that when lateral wear develops in the driving wheels it sets up stresses in rod jaws. By allowing sufficient play in the jaws to compensate for lateral wear in drivers, much of this stress would be relieved.

Stokers.—Ninety per cent of the so-called stoker failures can be traced right back to neglect on the part of firemen and are due either to lack of proper care in lubrication, to excessive wetting down of coal, or to allowing the hopper or feed trough to get clogged. Education and discipline is all that is needed here.

Slipped Tires.—During the past two years 31 failures due to slipped tires were reported. Of these 18 were man failures, pure and simple, and caused by excessive and unnecessary braking. There is room for more education, especially on E. T. equipment. All enginemen do not realize that the straight air will creep on if the automatic valve is not properly handled, and yet, even if ignorant, there is no excuse, as the small gage will always tell what is going on, if consulted.

Terminal Delays.—Failures are charged for any delay to engines at terminals, regardless of cause; therefore, the only logical way apparently of correcting them is to adopt the method in vogue on some railroads, viz.: make a double inspection, one on arrival and the other prior to departure. This, to many, may appear unnecessary, but the fact remains that all men will overlook something sometimes.

Walschaert Valve Gears.—All of the failures charged were due to poor design in so far as the fastening of the union link arm is concerned, and should not be classed as defects to the gear itself.

Steam Failures.—In nearly every instance, the alleged failures were due to inexperienced firemen, and this brings up a subject on which volumes could be written, viz.: the proper training of enginemen, a subject so broad, however, that it should not be handled in this report. In the same class can be placed the man failures, all of which though charged against the engine, were due entirely to inexperience or ignorance on the part of the men.

Let it be understood that this report is not intended to reflect discredit on the enginemen when speaking of ignorance or inexperience, but rather on the methods in use on too many of our railroads. New devices are continually being applied and too often men are expected to familiarize themselves with these with no other instructions than that contained in descriptive pamphlets. One ounce of ocular demonstration is worth a pound of reading in such cases. We feel that all new methods or devices should be thoroughly explained and demonstrated to the men whose duty it is to operate or work with them, before we can place ourselves in position to criticise. Every roundhouse where repairs are made can be fitted up with instruction rooms, containing charts or models or both, and certain hours or dates can be set when instruction will be given. Then if the men do not take these opportunities, action can be taken in case of man failure.

Railroad Administration News

Walker D. Hines Appointed New Director General; News of Interest to the Mechanical Department

THE appointment of Walker D. Hines, assistant director general of railroads and formerly chairman and general counsel of the Atchison, Topeka & Santa Fe, to the director generalship was announced by Mr. McAdoo at Los Angeles on January 11, and Mr. Hines entered upon the duties of his office immediately.

In announcing Mr. Hines' appointment Mr. McAdoo said: "Mr. Hines has been my assistant at Washington since the beginning of government control and has a thorough knowledge of the organization and administration of the railroads under federal control as well as the fundamental problem involved in the railroad situation. His ability and experience admirably fit him for the great trust and responsibility with which the President has honored him. Aside from his obvious qualifications Mr. Hines is in full sympathy with the policies which have guided the Railroad Administration and with the views of the President on the railroad question. I am sure that Mr. Hines will have the hearty support of the fine army of railroad officers and employees and I can ask nothing better for him than that they shall give him and the country the same loyal and effective service they rendered during my term as director general."

Walker D. Hines

It was announced that Mr. Hines will receive the same salary, $25,000 a year, which he has received during the past year as assistant to Mr. McAdoo and which was fixed for the directors of the departmental divisions of the Railroad Administration. In accepting the office Mr. Hines stated that he will carry forward the policies followed by Mr. McAdoo during the past year. He issued the following statement to railroad officers and employees:

"The President has appointed me director general of railroads, effective at once. I wish my first official act as director general of railroads to be this statement to officers and employees:

"Having been a part of Mr. McAdoo's organization from its first day, his policies are my policies and I intend to carry them out and to do so through the existing railroad organizations of the Railroad Administration.

"The responsibilities of the work cannot be exaggerated and there can be no success in it without your confidence and support.

"I shall gain and justify your confidence by prompt and fair treatment, but until you get a chance to know me and judge me by my works I want you to take me on faith and from the very first day help me to give the government the best possible service and the people the best possible transportation. You and I have been fellow workers in the hard work of the past year and I ask you to join me in giving the public even in time of peace the valiant and faithful service that you gave so heartily in time of war."

Mr. Hines was born February 2, 1870, at Russellville, Ky. He entered railway service in 1893 as assistant attorney of the Louisville & Nashville. He later became first vice-president of the road, following which he entered general law practice. In 1906 he was appointed general counsel of the Atchison, Topeka & Santa Fe and became chairman of the executive committee of that road in 1908.

As there is little probability that Congress will approve the five-year extension plan which has been strongly advocated by both Mr. Hines and Mr. McAdoo, it is believed in Washington that Mr. Hines' tenure of office will be short and that one of his principal duties will be to wind up the affairs of the Railroad Administration.

One of the first official acts of the new director general was the appointment of W. T. Tyler as director of the Division of Operation to succeed Carl R. Gray. Mr. Tyler entered railway service with the Wisconsin Central in 1883 as messenger. He has followed railroading consistently since that time, having been assistant to the vice-president in charge of operation of the Northern Pacific before he went to Washington last January as Mr. Gray's senior assistant.

During the month Thomas C. Powell, recently manager of inland traffic of the War Industries Board and formerly vice-president of the Cincinnati, New Orleans & Texas Pacific and the Alabama Great Southern, was appointed director of the Division of Capital Expenditures, succeeding Judge Robert S. Lovett. Mr. Powell was born in 1865 and since 1884 has been engaged in railroad service on lines connected with the Southern Railway System, starting as mail clerk for the Cincinnati, New Orleans & Texas Pacific.

INTERPRETATION OF WAGE ORDER

Director General McAdoo has issued the following interpretation No. 8 of General Order No. 27:

As there seems to have been a misunderstanding on some railroads as to the application of General Order No. 27, the said order is hereby interpreted to apply to all persons in the employment of the railroads earning less than $250 per month in December, 1915. Where such persons have not been granted the increases provided for in General Order No. 27 such increases will be made applicable retroactive to January 1, 1918, and until superseded by supplements thereto.

LOCOMOTIVE SPECIALTIES

The Central Advisory Purchasing Committee of the Railroad Administration has decided on the specialties to be used on the orders placed some time ago with the American Locomotive Company and the Lima Locomotive Works for 600 locomotives for 1919 delivery. Practically the same specialties will be used that were authorized for the locomotives ordered for 1918.

STANDARD LOCOMOTIVES DELIVERED TO JANUARY 18, 1919

Alabama & W. Point & Western Ry. of Ala.	2		0-8-0	American
Atlantic Coast Line	5		0-6-0	American
Baltimore & Ohio	69	Light	2-8-2	Baldwin
Belt Railway of Chicago	5	Light	2-10-2	American
Boston & Albany	10	Light	2-10-2	American
Central of New Jersey	10		0-6-0	American
	10	Heavy	2-8-2	American
Chesapeake & Obio	4		2-6-6-2	American
Chicago & Alton	10	Light	2-8-2	American
Chicago Junction	14		0-6-0	American
Chicago & Eastern Illinois	15	Light	2-8-2	American
Chicago Great Western	10	Light	2-8-2	Baldwin
Chicago, Indianapolis & Louisville	5	Light	2-8-2	American
Chicago, Milwaukee & St. Paul	50	Heavy	2-8-2	American
Cleveland, Cincinnnati, Chicago & St. Louis	25	Light	2-8-2	Baldwin
Duluth, Missabe & Northern	7	Light	2-10-2	American
El Paso & Southwestern	5	Heavy	2-8-2	American
Erie	16		0-8-0	American
	15	Heavy	2-8-2	American
Grand Trunk Western	16	Light	2-8-2	American
Grand Trunk	24	Light	2-8-2	American
Lake Erie & Western	15	Light	2-8-2	Baldwin
Lehigh & Hudson River	4	Light	2-8-2	Baldwin
Louisville & Nashville	20	Heavy	2-8-2	American
Michigan Central	20	Light	2-8-2	American
Mobile & Ohio	4		0-6-0	American
Nashville, Chattanooga & St. Louis	10	Light	2-8-2	American
New York Central	45	Light	2-8-2	Lima
	25		0-8-0	American
	50	Light	2-8-2	American
New York, Chicago & St. Louis	10	Light	2-8-2	American
Oregon Short Line	19	Light	2-8-2	American
Pennsylvania Lines West	20		0-6-0	American
Pittsburgh & West Virginia	3	Light	2-8-2	Baldwin
	2		0-6-0	American
Pittsburgh, McKeesport & Youghiogheny	10	Heavy	2-8-2	American
Rutland	2		0-8-0	American
	6	Light	2-8-2	American
Seaboard Air Line	10		0-6-0	American
	10	Light	2-8-2	American
Southern	20		0-8-0	American
	25	Light	2-8-2	American
	50	Light	2-10-2	American
Terminal Railroad of St. Louis	10		0-6-0	American
Texas & Pacific	11	Light	2-8-2	American
Toledo & Ohio Central	5		0-8-0	American
	15	Light	2-8-2	American
Union Pacific	10		0-6-0	American
	20	Light	2-8-2	American
Wabash	20	Light	2-8-2	American
Western Pacific	5	Light	2-8-2	Baldwin
Wheeling & Lake Erie	5		0-8-0	American
	10	Heavy	2-8-2	American

Total—		
Six-wheel switching, American		85
Eight-wheel switching, American		75
Light Mikado, American	286	
Baldwin	131	
Lima	45	
		462
Heavy Mikado, American		120
Light Santa Fe, American		72
2-6-6-2 Mallet, American		4
Total to January 18, 1919		818

ORDERS OF THE REGIONAL DIRECTORS

Railway Storekeepers' Association.—The Eastern regional director quotes a letter received from H. B. Spencer, chairman, Central Advisory Purchasing Committee, as follows:

"A meeting of the Railway Storekeepers' Association will be held at the Hotel Sherman, Chicago, Ill., on January 27, 28 and 29, 1919. The status of the association has been approved by the director general, and this is the first meeting which has been held since the railroads were taken under federal control. In view of the important economies which it is confidently expected to effect through the re-organization of the stores department which has been undertaken, and the desirability of having all of those who are charged with the duty of procuring, handling and distributing the material obtain the benefit of personal discussion of the many questions involved, we would appreciate it if you will request your federal managers to arrange to have as many of their purchasing and stores department officers as possible in attendance at this meeting. It is believed that this will greatly assist in the introduction of uniform practices, which it is the desire to establish as speedily as possible."

The Master Boilermakers' Association.—The Eastern regional director states that the Master Boilermakers' Association will hold its convention at the Hotel Sherman, Chicago, Illinois, May 26, 27, 28 and 29, 1919. As this organization has been recognized and encouraged by the railroads on account of its educational value, approval has been given for the holding of the convention. Please arrange for master boilermakers, boiler shop foremen, general boiler inspectors and others employed in a similar capacity to attend, as far as they can be spared without detriment to the service. Each road should follow its usual practice with respect to allowance of time and expenses and furnishing transportation for men who may properly be permitted to attend this convention.

Location of Air Pumps on Locomotives.—The Eastern regional director and the Southwestern regional director have issued orders stating that when air pumps are applied to locomotives, care should be taken that they are so placed as not to obstruct the vision of men on the locomotives; as locomotives receive Class 1, 2 or 3 repairs the pumps should be properly located.

Passes for General Chairmen of Committees of Employees' Organizations.—The Eastern regional director states that it has been decided that it will be the policy of the Railroad Administration to issue annual railroad transportation to the general chairmen of committees of employees' organizations, where the application is properly made and it can be shown that such chairman actually represents the class of employees he claims to represent. This will include also the granting of the necessary leave of absence in the usual manner during the incumbency of such chairman to enable him to carry on the business of his Association. It will be proper to honor requests of this character where annual transportation over the home road only is desired. Requests for off-line transportation should be forwarded to the Director of Operation.

Time Allowed for Lunch to Shopmen on Eight Hour Shifts.—The Eastern regional director states that pending further action by the United States Railroad Administration, the following will govern except when more favorable conditions are provided for by agreements in force: Men employed in shops or roundhouses where three shifts are worked and who work one of the three shifts, will be allowed a lunch period of not to exceed 20 minutes, with pay. Those employed in shops or roundhouses or other places where less than three shifts are worked are to have a meal period of not to exceed one hour, without pay.

Elimination of Sunday and Holiday Work.—The Eastern regional director reproduces a letter from the Director of Operations which is self-explanatory:

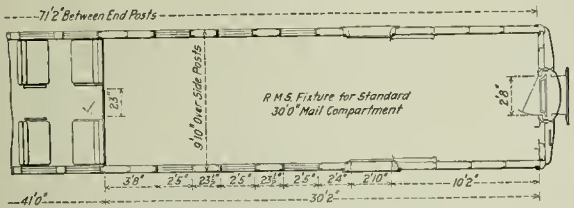
"If you have not already done so, won't you please immediately arrange for a thorough investigation and study to be made on the roads in your region with respect to the elimination of Sunday and holiday work, in order to carry out the desire of the director general as expressed in Supplement No. 13 to General Order No. 27.

"In order that the director general may know what progress is being made, and that his wishes in the matter are being fully met, I believe it advisable that you have your federal managers make reports from time to time indicating to what extent they have found it possible to either wholly eliminate or reduce to the minimum Sunday or holiday work."

Car Inspectors Needed.—The Eastern regional director states that C. B. Young, manager, Inspection and Test Section, 610 Southern Railroad building, Washington, D. C., is in need of car inspectors at plants building cars for the United States Railroad Administration and asks that railroads forward to him the names of men who are at present in their employ who would make good inspectors on car construction, and who could be spared temporarily to take up this work.

STANDARD PASSENGER CAR EQUIPMENT

THE Committee on Standards for Locomotives and Cars of the Railroad Administration has approved the general arrangements for the passenger; passenger and baggage; passenger, baggage and mail, and passenger and mail cars, the floor plans of which are shown in the illustrations. No other drawings, nor the specifications have been drawn for this equipment because of the uncertainty as to whether any of these cars will be built. All the cars are 70 ft. in length and are of the same general design. The



Half Floor Plan of U. S. R. A. Passenger and Mail Car

illustrations show the complete floor plan of the passenger car and half plans of the other cars, as the passenger end of all cars is the same. The designs for these cars will follow in a very general way that of the 70-ft. baggage car, a description of which was published in the *Railway Mechanical Engineer* for October, 1918, on page 561.

The following is a list of the specialties recommended by the committee for the standard passenger carrying cars:

Inside finish: Water and fireproof, ¼ in. mahogany window sills. Three star Agasote below wooden window sill and steel above.

Ceiling: Upper deck water and fireproof—three star Agasote ¼ in. thick. Lower deck water and fireproof—Agasote 3/16 in. thick. Deck to be painted with slush paint. Ceiling to be painted light color enamel of approved shade.

Ceiling decoration: Single plain sap green color line on lower and upper deck. Line only varnished over to hold decoration.

Window sash: Brass sash complete with fixtures as shown on Baltimore & Ohio blueprint No. 10,745. All windows to be double sashed except toilet room windows. Sash to raise 18 in.

Deck panels: All swinging deck panels to be equipped with T. U. Company's Eclipse ratchet. No deck sash to be used, swinging panels only at ventilators.

Window glass: American polished plate 3/16 in. thick, except in saloons and lavatories, which are to be equipped with pressed prism design 0-1, with smooth surface outside.

Door glass: American polished plate ¼ in. thick.

Window shades: Railway standard mercerized on inside, pantasote on outside. Width of curtain goods in windows not more than ¼ in. less than distance between window casing. Color of shade to be selected.

Shade fixtures: Rex, all-metal shade roller. Curtain Supply Company, ring type No. 88.

Shade rolls: Rex, all-metal shade roll.

Seats: Hale & Kilburn, walk-over type, high back, with head rest, steel ends, wooden arm rests, No. 197, or its equivalent.

Seat covers: Seat covering to be selected later.

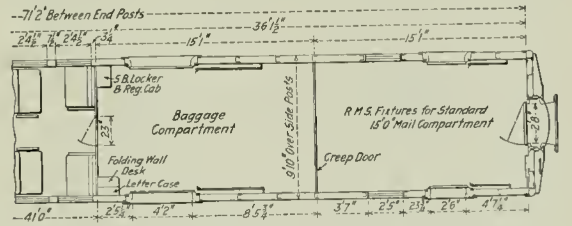
Ventilation: Clere story deck, eight per car. Utilities ventilator 100 per cent, Peerless 90 per cent, Garland-Honeycomb 75 per cent.

Water coolers: White metal, North Pole sanitary drinking fountains with filter attachment, arranged suitably to design of car.

Wash stands: White metal. Plumbing under wash stands to be open with nickel fittings. Wash stands fitted with Adams & Westlake throw-over lever type of faucets and drain fixtures of Pullman standard.

Water supply: Pullman standard air pressure water system. Galvanized steel piping. Cold water only. Metal tank box insulated.

Heating system: Chicago Car Heating Company's vapor system to be guaranteed by manufacturers to register an inside temperature of 70 deg. when the outside temperature is 20 deg. below zero. Holes through center sills for train line sufficiently large to prevent chafing of pipe due to expansion or contraction. Piping so applied as to give ample clearance



Half-Floor Arrangement of U. S. R. A. Passenger, Baggage and Mail Car

between all body and truck parts when cars are rounding 170 ft. radius curve. Same to include extra heavy pipe for train line.

Steam hose and couplings: Steam hose to be 1⅝ in. by 24 in. Couplings to be of the S-4 type.

Steam pipe: Train pipe 2 in. wrought iron. Pipe and fittings extra heavy. Piping inside of car 1¼ in. standard pipe.

Foot rests or guards: Pullman type, perforated steel.

Wrecking tools and cases: Steel box fitted with No. 6 sledge, axe, saw, fire bucket, hack saw, six hack saw blades, cold chisel and steel bar, located to comply with state laws.

Hardware: To be of the Pullman type.

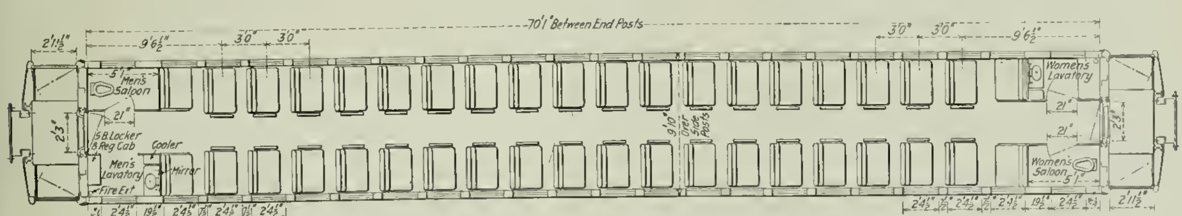
Floor covering: Floor covering to be of plastic material, thickness to meet linoleum ⅝ in. to the top of chanarch, and then an aisle strip of green or red linoleum laid so that the top will be on the level with the inlay and of suitable color to harmonize with the interior finish of the car, chanarch to be 22 B.W.G. gage galvanized. Brass strips to be placed on either side of the linoleum as shown on Baltimore & Ohio blueprint No. 31,189.

Equipment: One deck sash opener. One step box (Dunbar).

Basket racks: Three-section continuous type.

Coat and hat hooks: In saloons and lavatories.

Check holder: Fitch.



Floor Arrangement of the U. S. R. A. Standard 70-ft. Passenger Car

Platform and end of car: Cast steel integral with body bolster as manufactured by Commonwealth Steel Company, or built-up type of approved design.

Gates: Each car to be equipped with safety gates, Pullman type, and permanently attached at each end of car.

Steps: Steps to be of steel with metal safety treads of abrasive material and have no nosing.

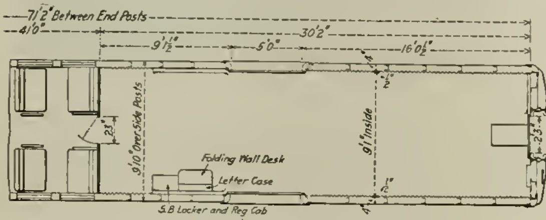
Draft gear: Miner friction class 5-A-P.

Buffer device: Miner friction, Class B-10, or equivalent.

Diaphragm upper buffer: Fowler upper buffer spring.

Vestibule: Wide type Pullman standard, with Imperial wide face plate.

End doors: Mahogany with finger guards.



Half-Floor Arrangement of U. S. R. A. Passenger and Baggage Car

Diaphragms: To be of steel. First choice Dunbar, Style C. Second choice, Pullman. Third choice, Rex.

Vestibule curtains: Pullman, first choice; Acme Automatic, second choice.

Vestibule shield: Pullman or Acme revolving type.

Vestibule curtain, hook and handle: Rex, first choice; Robertson Safety, second choice.

Vestibule trimming: Enameled body color.

Vestibule grab handle: All handholds, grabs, to be smooth wrought iron, ⅞ in.

Trap doors and lifting device: First choice to be T. U. Company's National high station platform type, arranged to open up after and outside of vestibule doors. Second choice, Edwards, and third choice, Pullman.

Air brakes: The Universal, common standard, high-speed automatic brake equipment, schedule UC-1-18, shall be used without electric features and with type K-1 automatic slack adjuster placed on brake cylinder. J. M. expander ring. Ten pound spring type retaining valve and one conductor valve.

The air brake shall develop a nominal brake power of 90 per cent of the complete light weight of the car with 60 lb. cylinder pressure, and be capable of 150 per cent braking power in emergency.

All parts of truck and foundation brake gear to withstand stresses in accordance with M.C.B. standards; 1¼ in. extra heavy brake pipe to be used. All pipe fittings except those regularly included in the air brake schedule shall be "Extra quality individually tested pipe fittings for railroad air brake service." All air pipe to be blown out before pipe is assembled.

Hand brakes: Miner or Western Railway Equipment, or Lindstrom improved.

Braking and signal cord: Signal cord, ¼ in. steel cord, braided green. Conductor's cord, ¼ in. steel cord, braided red, both applied along center of car upper deck supported.

Painting: U. S. Standard.

Roof: Steel. To be of material which has been thoroughly sand blasted, painted and sanded on the outside.

Trucks: Cast steel.

Truck wheel base: 11 ft.

Center plates and center pins: Cast steel separable, arranged for application to cone bolster locking center pin.

Side bearings: Frictionless rolled side bearings for six-wheel passenger trucks. Miner first choice, Perry second choice, Woods third choice.

Equalizers: Wrought iron.

Wheels: 36 in. rolled or forged steel.

Pedestals: Cast steel.

Journal boxes: National Malleable Castings Company's pedestal type complete with lids for axles with 5 in. by 9 in. journals.

Journal bearing keys: To be drop forged M.C.B. dimensions suitable for axles with 5 in. by 9 in. journals.

Brake shoe: Diamond S.

Floor insulation: To be 1 in. quilted hair felt with paper on both sides.

Insulation, super-structure: Body insulation to be ¾ in. quilted hair felt with paper on both sides applied to inner surface of the side walls and end sheets.

Saloon hoppers: Dayton Company's Eckert No. 8 with porcelain hopper chute as manufactured by Dayton Manufacturing Company, or Pullman Standard (Duner). Hopper in women's lavatory to have double lid and men's lavatory to have single seat with horseshoe opening. Toilet paper holder, Pullman type, to be applied in each saloon.

Designating signs: Pullman style, to show location of each toilet, one illuminated sign to read "Men" in end of car where men's toilet is located. Sign to be placed inside of car on bulkhead. Same method to be used at ladies' end and sign to read "Women."

The Standard Refrigerator Car*

The Designs Have Been Based on Results of Investigation Made by the Department of Agriculture

BY M. E. PENNINGTON
Food Research Laboratory, Bureau of Chemistry, U. S. Department of Agriculture

A SHORT time ago the Railroad Administration issued Mechanical Department Circular No. 7,** the opening paragraph of which reads as follows: "In order to insure the greatest possible degree of efficiency in refrigeration and conservation of foodstuffs, refrigerator cars having trucks of 60,000 lb. capacity or over, will, when receiving general repairs or being rebuilt, be made to conform to the following United States standard refrigerator car requirements." Then follow specific details and references to blueprints for the construction of the car in general, its insulation, ice boxes, and the many details of a refrigerator car.

Considering the fact that we have in this country more than 100,000 refrigerator cars, and that ultimately all will probably conform to the essentials just laid down by the Railroad Administration, it may not be amiss to review the circumstances which have led to the issuance of this circular.

In the latter part of the nineties and early hundreds the difficulties in the distribution of our perishables attracted an increasing amount of attention because the length of the hauls increased as more distant markets demanded supplies, and the losses from decay in transit kept pace with the distance traveled. Some of the shippers applied to the United States Department of Agriculture for assistance, among them the Georgia peach growers. In 1903 G. Harold Powell and his associates undertook to investigate the matter. They studied the effect on ripening of cooling the fruit quickly after picking and before loading in the car, as well as the development of decay in transit. Precooling, however, was not a reliable remedy because the insulation of the refrigerator cars of the south was, and is, insufficient to retain the chill imparted to the fruit and the air circulation in the cars was, and is, inadequate to transfer the refrigeration from the ice bunkers to the center and top of the load.

From Georgia peaches the investigators were called to California oranges. The industry was severely handicapped because of decay in transit. Again the inadequacies of the refrigerator cars were apparent. The investigations of the temperature in cars in transcontinental trips brought out the differences in various parts of the car and their relation to excessive decay in the middle and upper part of the load.

In 1908 the Food Research Laboratory, which had been studying the effect of long cold storage on poultry, extended the work to the handling of fresh goods in the packing houses and in transit. We soon found that standardized methods at the packing house did not give standardized results at the market; in other words, the refrigerator cars were a variable factor. It was not and it is not uncommon to find chickens on the floor at the bunker hard frozen, those quarterway of the car in a good chilled condition and between

*Abstract of a paper read before a joint meeting of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers.

**See *Railway Mechanical Engineer*, December, page 663.

the doors green struck, although the condition of the packages was practically uniform when they were loaded.

Then began the study of the construction of these cars. In 1913 the results were published as Bulletin No. 17 of the United States Department of Agriculture. The conclusions presented in that bulletin outline fairly well the lines of work since followed by the investigators and which have led to the information on which the construction of the standard refrigerator car is based. The concluding paragraph of the bulletin says, "It is eminently necessary that such questions as the most efficient and economic size of the refrigerator car, the exact amount of insulation required to insure the maintenance of low temperatures, or, conversely, to protect the contents of the car against frost, the equalization of temperatures in all parts of the car, and many others, be pressed for more exact and far reaching answers." The bulletin points out the importance of roof and floor construction in relation to insulation efficiency, especially the waterproofing of the floor, and also the efficiency of the wire basket bunker which permits of abundant air access to the refrigerant.

By the early spring of 1916 we had ready quite a number of experimental cars built by four roads in as many shops. The details of construction varied widely. This we considered advisable because we first had to establish the fundamentals of construction, such as the type of bunker and the action of floor racks, regardless of the car itself.

AIR CIRCULATION

It did not take long to decide that the basket bunker, insulated bulkhead and a rack four inches off the floor, with lengthwise stringers and cross slats about three inches wide and about two inches apart, are essential for the distribution of the refrigerated air. The wire basket hanging free in the end of the car permits the warm air entering at the top to flow without obstruction over the entire surface of the ice, and as it cools, to fall to the floor. At the floor it is not pocketed, but finds a ready exit under the rack, and so along the car floor and up through the load, gathering heat as it goes and carrying it to the upper bulkhead opening where again the ice has a chance to absorb it.

If we place thermometers in the air of the car to determine its temperature at the lower bunker opening, again at the middle between the doors, then at the ceiling, midway of the car, then at the ceiling quarter way, and finally about 10 in. in front of the upper bunker opening, we find a steady rise in temperature, the upper bunker opening thermometer being the highest. Generally we find from two to four degrees difference between the air in the upper middle part of the car and that at the upper bunker opening. If the thermometers are similarly placed in a car equipped with a box bunker with open bulkhead and without the floor rack, the graduations of temperature in the upper part of the car are just reversed. Here the temperature at the upper bunker opening is ordinarily from two to four degrees lower than at the middle of the car. This observation has been made again and again and is further confirmed by the performance of a box bunker combined with solid bulkhead and a floor rack, with which there is good cooling in the top of the load at the bunkers, but unsatisfactory results in the upper middle parts of the load.

Even more striking are the results obtained when salt is added to the ice in the basket bunker combined with the insulated bulkhead and floor rack, or the standard type bunker, as it is now termed. So rapid is the removal of the very cold air from the bottom of the bunker that fruit and eggs may be rapidly cooled throughout the car without frosting the packages at the bulkhead. Of course, the bulkhead insulated with one or two inches of a standard insulator is an essential if the packages against it are to be protected from the frigid air close to the ice and salt, but that this protection is not due entirely to the bulkhead is proved by the pocketing of the cold at the bottom of the bunker when the box bunker with an insulated bulkhead is salted. Then the packages at the bottom of the load, next to the bunker, are frosted. In other words, there is no force to the air movement and it cannot be distributed with sufficient rapidity to prevent the intensive chilling of itself. With the standard bunker and floor rack and a lading such as cantaloupes or oranges, as much as 9 per cent of salt may be safely used in the initial icing, and the same percentage or a little less may be used on the two successive days, by which time the load is cooled throughout. It is unnecessary to point out the great advantages accruing to the transportation of such perishables as berries, peaches and cherries by this ability to cool them rapidly while rolling. It is also of benefit to eggs, which, because of the character of the commercial package and the tight load, are exceedingly slow to cool in the ordinary car, the top and middle of the load being but little affected.

The question of insulation has been more complex. We have not only a compound wall, but one which is continually in vibration and which is moving constantly. To this constant movement of the insulator must be added the difficulties of making it continuous because of the framing of the car and the use of tie rods and bolts which offer heat runways.

INSULATION

The thermometers which were fastened tightly against the lining of the car very promptly and consistently indicated that roofs and floors must be better protected than the walls, and in the case of the floor and the lower part of the walls it is imperative to waterproof. Comparisons of cars having varying amounts of insulation, loaded with representative commodities, showed that for the safety of the load, as well as economy in loading and in refrigerant, it is necessary to have the equivalent of two inches of pure cork board in the side walls and ends, at least two and one-half inches in the roof and at least two inches in the floor, the insulation in the floor to be continuous from side to side and end to end. In other words, the insulation on the floor must not be broken by sills and it must be at least two inches of pure cork board.

It has not been possible, heretofore, to waterproof the floor. Consequently there has been wet insulation and a serious loss of efficiency. Therefore the findings of the department emphasize the need of cork board in the floor.

THE GOVERNMENT STANDARD REFRIGERATOR CAR

Such essentials of a refrigerator car as an adequate amount of insulation and air circulation had been agreed upon by the investigators prior to government control of the railroads, and certain lines had incorporated some or all of the findings into their new and rebuilt cars. In the standard refrigerator car* developed by the Railroad Administration, so far as possible, the trucks, draft gear, framing and other general construction features are standardized with the United States standard double wall box car. The essentials upon which rest efficiency in protecting perishables against heat and cold have followed very closely the findings of the investigators of the Department of Agriculture. The plans include unbroken insulation on both floor and roof. On the walls the insulation is continuous from door post to door post. It was not possible to devise a scheme by which the insulation could be run over the belt rails, but the exposed surface was reduced. All the insulation is applied in a solid mass, unbroken by air spaces. It is supported by pressure and not by direct nailing. The excess space afforded by the framing is left on the inner side, under the lining, to receive such nails as the shipper cannot be prevented from driving into the walls and which have played havoc with the insulation. Bolt heads and tie rod exits are protected by insulation. The bunker is a woven wire basket holding approximately 10,000

*See *Railway Mechanical Engineer*, December, page 663.

lb. of ice, surrounded by a 2-in. space and separated from the body of the car by a bulkhead carrying at least 1 in. of insulation, and last, but far from least, is a floor rack, 4 inches in the clear, built of 2-in. by 4-in. runners with 1-in. by 3-in. cross slats 1½ in. apart. This rack is hinged to the side walls. Each half may be turned up and the doorway section folds back to facilitate cleaning the car. The length of the car over end sills should be about 41 ft. and the loading space 33 ft.; it must not be more than 33 ft. 3 in.

FUTURE DEVELOPMENTS

On the basis of a standard car the department is now predicating a standard icing service which should save foods and money. It is also working on standardized methods of stowing loads and the standardization of packages. The ability quickly to cool certain commodities in transit by the use of salt with the ice has given a new impetus to orchard, field and packing house handling, while the reasonable assurance of proper care in transit of such products as dressed poultry lends a stability to the industry which is much needed. There has been much discontent on the part of shippers of products requiring intensive refrigeration because they could not obtain such cars as the large meat packers are using. The United States standard refrigerator car will carry meat hung from rails quite as successfully as the cars built especially for meat. In addition it will carry package loads on the floor under the meat better than the meat cars. An important difference in the standard car as compared with the meat car is the reserve of ice in the bunkers which are often amply supplied when the tanks of the meat cars need replenishing. Neither is there visible in practicable results the advantages supposed to accrue from the retention of the brine, provided coarse rock salt is placed *on top of the ice* and so forced to bore its way through the whole mass before finding an exit. We have wasted much salt in the past, as well as ice and foodstuff for lack of knowledge.

For every standard car turned out of the shops there will follow a saving of food, a saving of money and a saving of labor. To that end the Department of Agriculture has worked long and patiently and to that same end the Railroad Administration has now issued Mechanical Department Circular No. 7, and has also indicated its intention of reminding the railroads of the instructions.

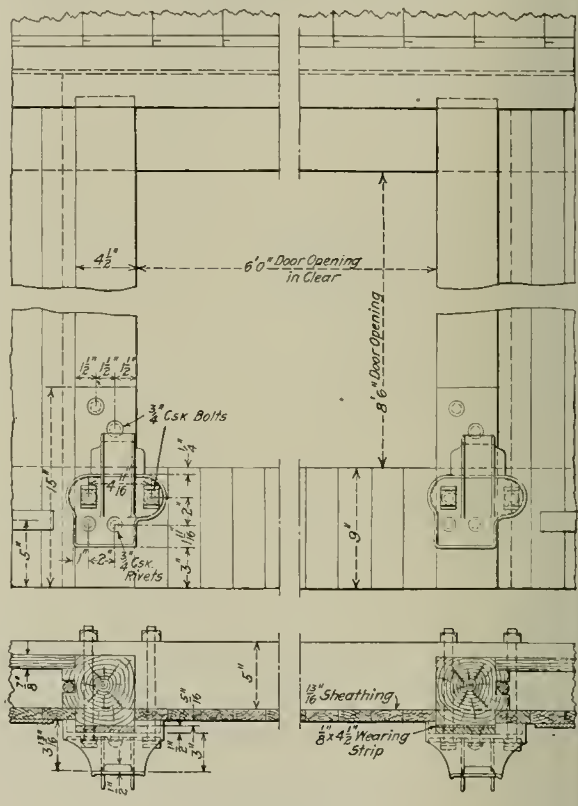
Truly, facts, faith and friendly co-operation have brought about a consummation long and earnestly desired.

MAKING BOX CARS EFFICIENT GRAIN CARRIERS

BY E. K. HOGAN

Investigation shows that a large majority of all the leaks of grain from box cars occur between the car sheathing and the side sills, due to the tendency of the sheathing to spring away from the sills under load. Nails do not effectively and permanently hold sheathing boards firmly and tightly to the sills under the strain to which cars are subjected.

One successful remedy for this condition has been the application of sheathing straps of flat iron, size ¼-in. by 1½ in. to the sides of the box cars. These straps are fastened by bolts through the side sills together with rods that extend through both side and intermediate sills. It has been the observation that no more adequate protection against sheathing leakage than these straps can be applied to a car. In applying straps of this kind it will be found that iron of the dimensions given above is much more desirable than straps

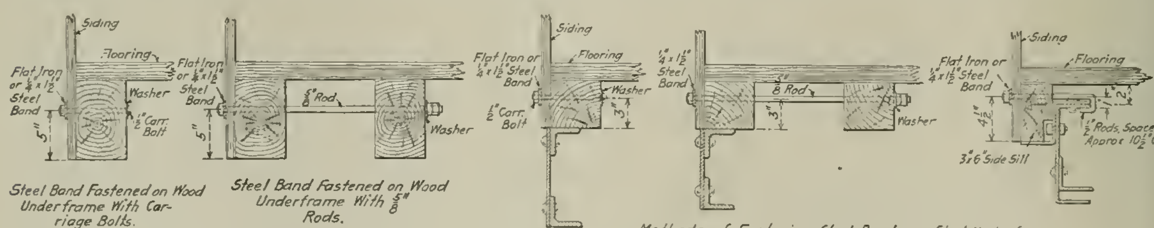


Box Car Door Guides with Steel Plate Attachment Bolted to the Door Posts

of greater width, which would not shed moisture as well and might cause the sheathing to rot under the straps.

On some steel underframe cars the sub sill is of such light weight or the frame of such construction as to preclude the application of bolts to hold the sheathing straps. This difficulty has been met by the use of J-bolts, as shown in Fig. 1.

Some grain losses are ascribed to the prevalence of warped, twisted and loose grain strips. It has been our experience that this leakage is primarily due not to faulty grain strips but to the fact that flooring is improperly and insecurely fastened to side sills. Flooring fastened by nails to the side sills will in course of time spring up at the ends, which per-



Methods of Preventing Box Car Sheathing from Working Loose from the Side Sills mits grain to run underneath floor and over the inside edge of side sill.

The only remedy that would overcome this condition would be to bolt the flooring to the side sills, and it is the recommendation that straps of flat iron, the same size as those applied to the sheathing, be applied to the flooring along the side sills just inside of the post line. These straps should be fastened by bolts extending down through the sills. This method would be much more secure than placing bolts through the grain strips, which are in short lengths and liable to split. The use of sheathing and floor straps, both bolted through the side sills, together with adequate door protection, would make cars of wooden construction grain tight.

Many experiments have been made by railroads to discover a box car side door that will successfully perform its functions. As a result the up-to-date box car usually has a strong, durable side door. The greater problem really has been to hold it properly to the car. Success in this depends largely on the door post and the door guides. Grain doors are nailed to the door post and when removed the nails are left in the post which weakens it considerably and lays it open to moisture and rot. Because of this all door posts should be equipped with a well fitted nailing strip of at least 1¼-in. stock covering the entire inside face of the post.

Insecure doors and grain leakage is often caused by door posts being burst out because of rotten tenons or other reasons. A remarkably good arrangement to strengthen the door post has been successfully applied by one road to all of its box cars. This is shown in Fig. 2. The door post, besides being tenoned into the side sill, has an outside extension down to the bottom of the sill. A wrought iron plate is fastened to the door guide by means of two rivets. This plate extends up the post, to which it is secured by two bolts. The two bolts through the door guide pass through the side sill, one of them also passing through the extension of the door post. This not only holds door post in place but makes it impossible to pry or hammer down the door guide to gain entrance to the car. It is a more economical and as satisfactory as any of the so-called "burglar proof" door fixtures on the market.

Grain spoiled or damaged by water on account of leaky roofs is so much grain lost. To avoid breaks and leaks a roof must be flexible. It is contended that the most satisfactory roof yet discovered is the steel roof of heavy gage metal. Without taking issue with this assertion I wish to describe a method of applying the much derided light metal roof which has been found to make it wear 50 to 75 per cent longer. A single board wood roof is first laid over the purlines, crosswise of car. This is given a heavy coat of Baco or Sarco preparation and covered with one layer of plastic paper, over which the roof sheets are laid. It has been found that the tar in the paper is an excellent lubricant and preservative of the metal. This preparation, besides its waterproofing qualities, prevents nails that become loosened in the board roof from wearing their way up through the roof sheets.

Lumber for Car Construction*

Selecting Proper Grades to Secure Strength and Lasting Power, Increasing Service by Preservatives

BY DR. HERMANN VON SCHRENK

A GOOD many years ago I went abroad to study questions of economies in maintenance. The most impressive fact which I came back with was the striking view point that most of the European engineers had of the necessity of a thorough comprehension of the materials that they were working with and their high degree of respect for what they were working with. They furthermore, did not hesitate to change their methods of using material, provided some way was shown to them by which they could bring about not only greater economy but increased fitness and adaptation. We in this country have been prone to stick to precedent. The tendency to continue methods simply because they have been in use a great many years is characteristic of much of our railroad practice. We are rather slow to change, particularly when it comes to the question of using material. It is not astonishing that we have got into such habits, because in the first place we have had such an enormous amount of raw material and it has been easily available. If there is one lesson that the war has taught us it is that we have been slipshod in the use of our material.

One of the chief difficulties in the construction of cars, referring of course entirely to lumber, has been the extremely vague way in which most of the lumber used in a car has been described and the even vaguer appreciation on the part of those who are repairing cars as to what might be expected of various kinds of wood. The lumber men and the officers of most of our roads specified one or two kinds of wood because they had always been used. White oak and white pine were the woods that were most readily at hand in the earliest days and were long recognized as the best. Consequently for years they were specified and used and they are still being specified. This is a remarkable fact; it is not only the case with the railroads but also with the government. I was present at a meeting revising government specifications for lumber and it was found that they called for clear white pine an inch and a quarter in thickness, dressed on both sides—lumber which has not been manufactured for a great many years.

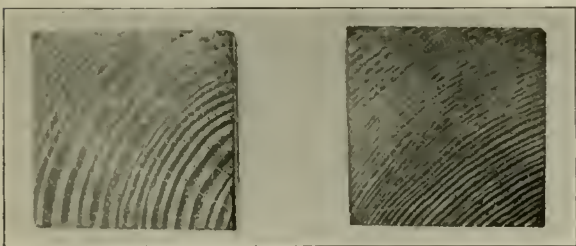
Now what has been done for the average man interested in the construction of cars that might enable him to get better service out of the material? The best way in which he can do that is to specify more closely the kind of lumber that he wants for his construction and to specify it so that he will get a reliable class of material. The specifications under which lumber was bought in the last year on one of our biggest trunk line railroads was "yellow pine, long leaf, grade B or better." It is against that kind of practice that I would caution you.

As a result of a long series of studies made in co-operation with the American Society for Testing Materials and the U. S. Forest Service, a standard specification was adopted by which yellow pine lumber could be visually inspected instead of describing it. I have a chart which was furnished me by the engineers of the United States Forest Service, having four pieces of long leaf yellow pine (Fig. 1). They are all botanically long leaf pine, but you will notice the modulus of rupture varies from 11,110 lb. to 4,660 lb. per sq. in. There is not any way in which you could identify these as long leaf pine; you would have to accept it under

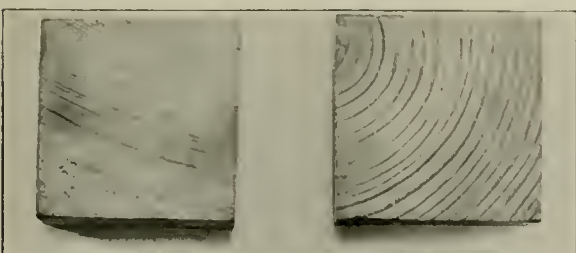
*From an address before the Western Railway Club.

the usual specifications, but notice the difference in the quality which is furnished. From this you will get an idea as to what grade of pine ought to be specified, particularly from the standpoint of strength. If you want a piece of timber in a car where strength is required as in sills, posts or braces, the specifications should call for a dense piece of pine instead of the ordinary long leaf pine, because in specifying that you will get a strong piece, as you will see from the chart. The term "long leaf" does not take care of that.

After the density rule had been developed some members of the M. C. B. Association raised the question, "Are we sure when we specify this grade of dense pine, that we will also get a stick which will last?" A few years ago the poorest as well as the best grades of southern pine were put under a testing machine to determine their strength and were also submitted to decay producing influence, in order to see whether there was any relationship between the strength and the lasting power. It was discovered that the strong pieces were also the ones that had the greatest length of life. The results of these tests are shown on the curve in Fig. 2. This demonstrates clearly that if you obtain a good, dense-grained piece of southern pine, you will also obtain a long-lived piece. In making experiments with car sills for the last few years, I have been impressed with the fact that those in which a high



Modulus of Rupture	11,110 lb.	Modulus of Rupture	10,750 lb.
Specific Gravity	.639	Specific Gravity	.598
Per Cent Summerwood	55	Per Cent Summerwood	52
Rings per inch	10	Rings per inch	23



Modulus of Rupture	4,660 lb.	Modulus of Rupture	5,520 lb.
Specific Gravity	.432	Specific Gravity	.440
Per Cent Summerwood	....	Per Cent Summerwood	25
Rings per inch	32	Rings per inch	10

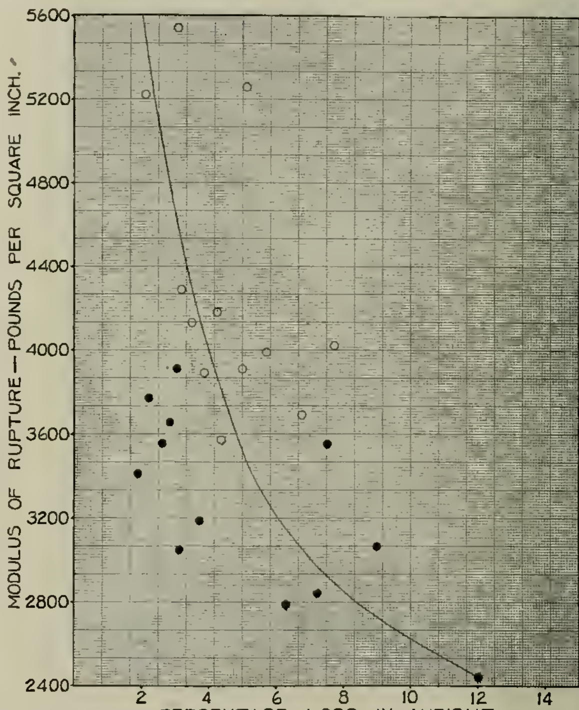
The two upper blocks show typical sections of timber with a large percentage of summerwood. Both have high density or specific gravity and a high modulus of rupture, although the rings per inch vary greatly. The two lower blocks show a small percentage of summerwood. The specific gravity is low in both cases and the modulus of rupture shows the ultimate strength is only about one-half as great as for the dense wood. The tests were conducted on small, clear specimens of green material.

Fig. 1—Samples Illustrating the Properties of Yellow Pine

percentage of failure was found were the pieces that fall in the low part of the curve. The pieces which brought the car to the shop were in very rare instances the pieces that were in the high points of the curve.

A third series of tests was made to determine whether we had to specify long leaf pine at all. The question was raised two years ago in one of the committee meetings of the M. C. B. Association as to whether it was safe to use pine lumber other than the strict long leaf variety brought from Louisiana, Texas, Alabama or Georgia. Without going into details I will state that it makes no difference whatever what kind of pine tree the lumber comes from, whether it is lobolly, short leaf or long leaf: all have equal lasting power or strength, provided they are of the same density and provided they are all heart wood. In other words, exclude young saplings and you will get as long life out of one as out of the other, provided it has the same density. The comparative resistance to decay of heart wood and sapwood is well brought out in the samples as shown in Fig. 3.

A great deal has been said about the possibility of increas-



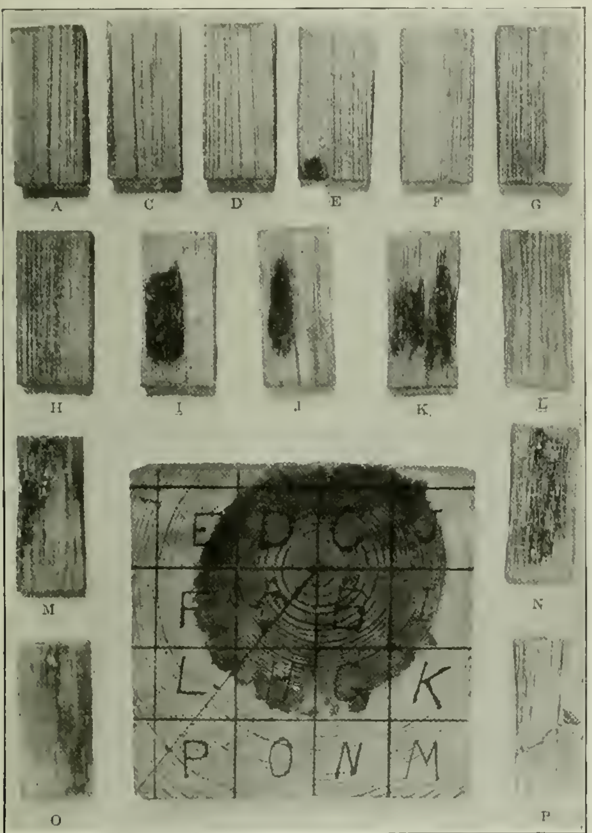
Two samples were taken from the same piece. One was broken in the testing machine and the other was subjected to decay producing influences for 18 months, after which it was dried and weighed. The percentage loss of weight indicates the amount of decay that had taken place. The strongest pieces also showed the highest resistance to decay.

Fig. 2—Curve Showing the Relation Between Strength and Resistance to Decay of Southern Pine

ing the service of lumber after we buy it by some kind of preservative treatment. It is rather surprising that the car men are so far behind the rest of the engineers in availing themselves of that opportunity. There are only two roads, the Burlington and the Santa Fe, so far as I know, that make a practice of creosoting sills and flooring, particularly of stock cars. I recently examined some cars that the Burlington built, over five years old, none of which have come back for repairs. They have creosoted sills and creosoted flooring, and in all of the cars the creosoted parts are in just as perfect condition as the day they were first put out. Now, if the Burlington can get such service out of creosoted lumber, is it not a shame for us to get three or four years' life out of material, when we might increase the length of life we ordinarily get five or six times?

Do not understand me as advocating anything less than a system of impregnation which will force the preservative into the timber. At the present time that is not very practical because our supply of creosote is short, but when normal conditions are restored I do not see why we cannot have a widespread treatment of car parts which are not subject to mechanical stresses, but in which lasting power, namely the protection against decay, is a vital factor. The ordinary scheme which I have seen applied here and there, the spraying of a preservative on timber, I personally have little use for, because a perfect impregnation is not obtained. The expectation of a prolonged life cannot be secured, so the spraying of the preservative onto the car is more or less a useless proceeding and a false protection. Putting it over joints and tendons when pieces are put together may be of some slight protection, provided the lumber is absolutely bone dry, but the practice of putting preservatives on promiscuously should be discouraged rather than encouraged.

One other factor in car construction that will assume increased importance in the near future is a more careful selection of kinds of woods for special types and purposes. I have referred to the fact that we have used only one or two kinds of wood in the past; we are still doing that to a large extent at the present time. There are a good many woods



This illustrates the rapid deterioration of the sapwood and the resistance to decay of the heartwood. The letters on the small blocks correspond with those on the larger block.

Fig. 3—Blocks of Shortleaf Pine After Being Subjected to a Wood-Decaying Fungus for One Year

available which ought to be used more widely than they are at the present time. Beech is one of them that is rapidly coming into use. I know of one road that has used beech very freely mixed with various kinds of red oak. If used in places where the material is not subject to decay, for instance, in the interior of finished cars, for posts and braces, particularly in the upper section of the car, it ought to give just as good service as oak. With the great trouble we have had in getting car lumber the increased supply of beech available for construction, particularly for box cars, is going to make a very welcome addition to our depleted stocks.

There is another wood which, when our tropical commerce becomes re-established, will play a large part in the construction of refrigerator cars. That is the balsa wood, weighing about 7 lb. per cu. ft., or about half the weight of cork.

The field for the saving of lumber in various lengths and sizes is too big to more than refer to. If there is one place in railroad construction where closer adaptation of different sizes and lengths and particularly grades of different lumber can be obtained than in the car repair shop I do not know where it is. I recently tried to compile a list of the requisitions as issued by the car department on one of the eastern lines for different uses in repairs of freight cars and tried to correlate them by substituting grades which I knew would serve the purpose of the railroad equally well as some of the other woods. I hate to tell you the difference in cost.

With the increased refinement in the grading and manufacturing of various kinds of lumber, I believe it to be the duty of every man interested in repairs of cars to study with the greatest care the revised grading rules which have been established by the various lumber manufacturing associations, for hardwood as well as pine and fir. These associations issue also engineering manuals, and no car man ought to be without them. If that were done such specifications for lumber for cars as I have found in use on some railroads would become practically impossible. One of the biggest railroads running out of Chicago in its specifications simply gave two words to the discussion of the timber, said a few words about the dimensions and practically told the man who was going to furnish the lumber, who was the purchasing agent, to use his wits. They wanted some wood; that is about all the specifications said. If you look over your own specifications and ask yourself, to what extent that example has been followed, you will know what ought to be done.

DISCUSSION

A. LaMar (Penn. Lines): I would like to ask whether balsa wood can be secured for car construction?

Dr. von Schrenk: Practically all that is available is used for life preservers. The wood, however, will probably be very much more plentiful when our shipping facilities are rearranged. It is found in Brazil, Costa Rica and the West Indies. It is heavily impregnated with paraffine because it is very short lived otherwise. It is a remarkably strong wood considering its light weight and it is an almost perfect insulator. As soon as it is available in larger quantities it ought to be of great value as lining for refrigerator cars.

G. S. Goodwin (C. R. I. & P.): Dr. von Schrenk has mentioned preserving lumber for car construction. Would he stop with the sills or would he apply preservatives to the posts, braces, siding and roofing?

Dr. von Schrenk: That would have to be determined by the type of car and by the grade of lumber being used. It might be advisable to use it in the first place in stock cars or in any cars where the wood is subject to a maximum degree of deterioration because of decay. The requirements are different for the lumber used in different parts of the car, because some pieces in a car are destroyed mechanically by abrasion, by shocks due to the impact of one car against the other or by other factors which cause the material to break mechanically. The other cause of depreciation is rot or decay. Against mechanical destruction no amount of preservation will avail; against decay, preservation will bring about excellent results. Obviously it is a very foolish proceeding to expend money on preservation of those parts of a car that would be subject to a very short normal life due to shock or breakage. I found the places in cars where it would pay to use preservative to be the sills in all types of cars and all flooring, and possibly also the posts in cars which are subject to continuous moisture, particularly stock cars. I doubt whether it would pay, unless a low grade of sap lumber were used, to treat all parts indiscriminately. In some types of roof construction it would undoubtedly pay to treat the roof boards also, particularly where there is more or less leakage. That may mean that you want to use two different types of preservative. In the case of sills and flooring in stock cars, the only thing that you could afford to use would be creosote. In the case of posts or roof boards which would not be subject to the wetting and drying you could well afford to use the cheaper zinc chloride. It would have the additional advantage that the material would not be disfigured, and it would probably give a sufficiently increased length of life to pay for the original investment.

H. S. Sackett (C., M. & St. P.): The railroads should be more insistent and more careful in demanding a better class of material for car sills, car framing and other parts where strength is important. One of the mistakes that railroads generally make in the use of wood is that they do not season it properly before they use it. We are not giving wood as good a chance as we do other materials. I know that the railroad officers do not like to see a lot of lumber piled up around the yards, but if they could be impressed with the added service obtained from properly seasoned wood, they would not object to larger lumber piles.

In many cases the railroads are using a better grade of wood than is necessary and that is one field in which we can develop great economies. It has been the custom of the railroads generally to use clear material for car siding. In Douglas fir we use No. 2 clear and better and in yellow pine B and better, not only for the construction of new cars, but also for the repair of old cars. By far the larger part of the material is used for the repairing of old cars which may have a life of five or possibly ten or twelve years. The Chicago, Milwaukee & St. Paul is considering the use of "sound knotted" material for car siding. Clear material costs about $36 a thousand and sound knotted material would cost about $24. I do not see why a good sound knot should be objectionable in car siding. I do not mean encased, loose, unsound or black knots.

Dr. von Schrenk: I cannot see any objection to using that class of material. I think that it is simply another case of precedent. All you care for in the siding of a double sheathed car is to keep it weather tight, and it does not make any difference particularly what the outside looks like.

Mr. Sackett: In the use of southern long leaf yellow pine the question of how much sap should be allowed has always come up, whether used for a carsill, car framing, stringer or other purpose. In the Douglas fir, the question of sap has not been so prominent, probably because the sap in the Douglas fir is not of the same character as the sap in the yellow pine—it does not rot so quickly. I should like to ask Dr. von Schrenk's opinion with regard to that. In the case of carsills for example, assuming in the yellow pine it was required that 85 per cent of the material should be heart wood what would be the equivalent in the Douglas fir? In other words, what is the comparative life of the sap in the two woods?

Dr. von Schrenk: If in the pine 85 per cent girth measurement was required to be heart wood, I should be inclined to require the same in the fir. I am judging from recent experience with bridges that had pine and fir timbers. In the same length of time they were both practically in the same state of decay. It should be rather easier to conform to the requirements in the fir, owing to the smaller percentage of small timbers.

ALL-STEEL COACHES FOR THE EGYPTIAN STATE RAILWAYS

BY FREDERICK C. COLEMAN

Thirty all-steel third-class passenger coaches have been put into experimental use on the Egyptian State Railways, and these are now being largely used in connection with the transportation of military personnel. The leading features of the design are clearly shown in the photographs. The cars are 65 ft. 0 in. long over the platforms and have a maximum width over the belt rail moulding of 9 ft. 7⅞ in. The cars have a light weight of 73,360 lbs., and are designed to carry 107 persons seated. The trucks have Fox pressed steel frames, with a wheel base of 8 ft. and 4¾ in. by 9 in. journals.

The panelling and framing is of steel throughout, finished on the inside with asbestos board. The coaches may be freely washed out with a hose without any risk of water lodging so as to cause corrosion. The floors are of Decolite cement, provided with wash-out plugs, and experience in the hot climate of Egypt has proved them to be quite as cool in hot weather as the ordinary wooden type of coaches. The all-steel coaches have the added advantage that they can be cooled down more readily after sun-down than the wooden coaches as a result of the system of air circulation between the outer and inner walls.

Egyptian State Railway Steel Passenger Coach

The underframe and body are incorporated into one structure. The body side pillars are connected at the bottom through the side sills to the boxed ends of the underframe crossbars, except at the bolsters, and at the top they are connected direct to the carlines, a method of construction which makes for several strong girdles completely around the body and frame. These are further stiffened by diagonal braces between the backs of the seats fixed to the pillars at their upper ends, and to the underframe crossbar flanges at their lower ends. A test load distributed along the floor caused practically no deflection. Free air circulation is provided throughout in the body between the outer and inner linings. The asbestos lining is carried inside the body sides and the lower roof with a free air space of 8¾ in. at the roof centre. As previously mentioned, the design is so arranged that there is no place for lodgment of moisture in the panels and frame, and as a further means of preventing corrosion the bodies are arranged in such sections that they can be thoroughly stoved after they are prepared for erection. These coaches are built for the 4 ft. 8½ in. gage, and the draw-gear, buffing gear, brakework,

Interior of a Partially Finished Coach Showing the Steel Frame Work

journal boxes, wheels and axles, trunks and other details, such as windows, louvres, seats, lavatory and other fittings, have been arranged to accord with the standard practice of the Egyptian State Railways. The existing timber coaches have tare weights per passenger of from 836 to 992 lb. As compared with these the steel coaches have each an average of 685 lb. per passenger. This advantage in weight is due in a measure to the reduced thickness of sides which permit an extra passenger on the transverse seats. Without thus utilizing this extra seating space or by giving each passenger additional room the tare weight would then show about 810 lb. per passenger. The makers claim that this result will certainly be improved upon when orders for steel coaches are given in the same quantities as is usual in Great Britain for timber coaches, and experienced builders are given a free hand in design and manufacture. Such large orders will permit of the scantlings of the required sizes being more readily obtained, and the net result will be that the railways will undoubtedly benefit, and obtain even lighter coaches than has been possible in existing circumstances. Briefly summarized, the all-steel coaches have the following advantages when compared with the timber coaches as used on British and Colonial railways. They are lighter in structure, with increased capacity; they are stronger and better able to resist wear and tear; they have proved to be quieter in running; they are more economical in first cost and maintenance; there is no danger from fire, and the strong construction of the ends, which have strong vertical girders with very rugged corner pillar pressings, will prevent telescoping. These all-steel coaches were built by the Leeds Forge Company, Limited, of Leeds, England, and the designs were prepared and developed by the builders in collaboration with R. G. Peckitt, the chief mechanical engineer of the Egyptian State Railways, Cairo.

ANNUAL REPORT OF I. C. C. BUREAU OF SAFETY

The following is an abstract of the annual report of W. P. Borland, chief, Bureau of Safety of the Interstate Commerce Commission, for the fiscal year ending June 30, 1918:

The following analysis affords opportunity for ready comparison of the results of inspections of safety appliances on railroad equipment with previous years:

	1914	1915	1916	1917	1918
Freight cars inspected	790,822	1,000,210	908,566	1,100,104	1,059,913
Per cent defective..	5.79	4.77	3.72	3.64	3.92
Passenger cars inspected	26,746	33,427	27,220	29,456	25,732
Per cent defective...	1.04	2.85	1.82	.85	.56
Locomotives inspected	32,761	38,784	31,721	37,199	33,806
Per cent defective...	4.98	4.06	3.66	2.69	2.18
Number of defects per 1,000 inspected.	67.48	57.23	45.56	41.16	44.01

It is to be noted that the present report indicates the maintenance of the low percentage of defects found in equipment inspected which has obtained for the past three years, which is all the more remarkable considering the increased traffic, congested conditions existing during the months of December, January, and February, abnormal weather conditions of last winter, scarcity of labor and materials, etc.

Table I presents a classified summary of the defects reported by the commission's safety-appliance inspectors. Analysis shows that the condition of air-brake equipment, to which attention was directed in the last annual report of this bureau, has not improved. Out of a total of 49,270 defects reported, 24,707, or practically 50 per cent of the whole number, are defects to the visible parts of air brakes. The number of air-brake defects reported per 1,000 cars inspected was 22.07, as against 19.01 for the previous year. The number of freight cars inspected in 1918 was 1,059,913, as against 1,100,104 in 1917, showing a decrease of 40,191 in the number of cars inspected; but the number of air-brake defects reported increased from 22,181 in 1917 to 24,707 in 1918, an increase of 2,526.

This is a condition that demands serious attention on the part of those who are responsible for the maintenance of this equipment, as both safety and economy in train operation require the maintenance of air brakes to the point of their maximum efficiency. On level roads, where braking conditions are less severe than on roads having steep mountain grades, there is a tendency to neglect air-brake maintenance, thus imposing an excessive burden on the inspection and repair forces of the latter roads in order to provide for the safe movement of cars received in interchange. No logical reason for this tendency ever did exist, as a proper compliance with the provisions of the safety-appliance laws requires that brakes be maintained to the same degree of efficiency on level roads as on roads having steep mountain grades. Now that the roads are being operated by the federal government as a unified system the disappearance of this tendency may be looked for.

Table II represents the condition of the air brakes on trains as they left the terminals after terminal or standing tests had been made, and illustrates the importance of these tests. What is often believed to be a 100 per cent air-braked train is in fact much less. The standing test is the only reliable and efficient method of ascertaining the condition of the individual brake, on which, if found to be inefficient, adjustments can be made at once which will insure an adequate brake. A standing test should be made of each and every train before it leaves its terminal, and no car should be permitted to go forward which has an inoperative or inefficient brake.

The Eighth Circuit Court of Appeals in a recent case held that every hauling or handling of a defective car for any other purpose than repair is forbidden by the terms of the proviso of section 4 of the act of 1910. That is, that a defective car cannot be handled for the purpose of delivering its load to the consignee even when unloading is necessary for repair, unless it be affirmatively shown that such delivery involves no more movement or handling of the car than unloading it or transferring its load.

TABLE I.—Classified Summary of the Number of Defects Found per 1,000 Cars and Locomotives Inspected During the Fiscal Year Ending June 30, 1918

Couplers and parts	4.21
Uncoupling mechanism	4.50
Visible parts of air brakes	22.07
Handholds	3.33
Height of couplers	1.22
Steps	.52
Ladders	1.07
Running boards	1.92
Hand brakes	4.89
Safety railings	.02
Footboards	.16
Pilot beam sill steps	.02
Handrails	.02
Steps for headlights	.01
Power brakes	.004
Asb pans	001
All classes	44.01

TABLE II.—Summary of the Results of Terminal Tests of Air Brakes from July 1, 1917, to June 30, 1918

Trains	1.017
Cars	30,701
Air cars	30,699
Non-air cars	2
Brakes cut out	323
Brakes that did not apply	1,431
Brakes that operated	28,945
Cars not controlled by air	1,756
Cars controlled by air	28,945
Percentage of cars controlled by air	94
Brakes with excessive piston travel	148

The receipt of cars in interchange with defective safety appliances has been one of the common mistakes of the carriers, under the erroneous belief that such cars could be handled to a repair point without liability for the penalty. There are several decisions holding that a defective car can only be moved for the purpose of repair by the carrier upon whose line it became defective, the most recent of which is by the Sixth Circuit Court of Appeals, in which it was held that the necessary effect of the clause "and such equipment shall have become defective or insecure while such car is being used by such carrier upon its line of railroad," as used in the proviso of section 4 of the act of 1910, is to limit the right of hauling a defective car for repairs, without penalty, to the carrier upon whose line of railroad the car was being used when the equipment became defective.

In this connection attention is directed to Circular No. 7 of the Division of Transportation of the United States Railroad Administration, a portion of which relates to the offering in interchange of cars having safety appliance defects, under which the law as interpreted by the various courts will be observed together with the elimination of the dangerous practice of offering defective equipment to connections, thereby insuring the maximum of safety in operation and at the same time expediting traffic.

It is as yet too early to express definitely the degree of success attained under General Order No. 8 of the Director General of Railroads, in comparison with the former method of instituting suit for the penalty for violations under the statute. Under the former system there was a double purpose served by prosecutions for the penalty, that of publicity in defending such suits and the disciplinary measures taken by the carrier to prevent subsequent cases being filed. On the other hand, the remedy at present is that of discipline of employees, which it is believed will be efficacious when promptly and justly administered. Great care, however, must be taken to place the responsibility on the proper party regardless of position, so as not to permit the shifting thereof from officials to employees or evasion in any manner.

In addition to their regular inspection work during the past fiscal year, our inspectors investigated 91 train accidents and assisted in conducting a number of tests of safety devices. One of these tests, that of the automatic straight air brake, required the services of 10 inspectors for a period of more than two months. During the past winter also 42 inspectors were employed from January 1 to March 14 in investigating for the Railroad Administration the serious congestion of railway traffic which prevailed during that period. Performance of this special work will account for the fewer number of cars inspected shown in this report than is shown in the last annual report of this bureau. In the performance of all the exacting duties imposed upon them, our inspectors have displayed marked ability and have fully maintained the high standard of excellence which has always characterized their work.

INVESTIGATION OF SAFETY DEVICES

During the year plans of 88 devices were presented for consideration; 93 devices were examined and opinions thereon transmitted to the proprietors. Of the number examined, 74 were so impracticable or crude that they were considered worthless; 10 were devices which were not intended primarily to promote safety and which would not affect the safety of railway operation sufficiently to warrant further consideration; 3 possessed meritorious features, but as a whole required further development before being entitled to serious consideration; and 6 possessed merit as safety devices warranting some degree of commendation. Of the devices examined which were commended, two were handbrake devices, one was an air-brake attachment, one was an automatic connector, one was a water sprinkler for locomotives, and one was a door for box cars.

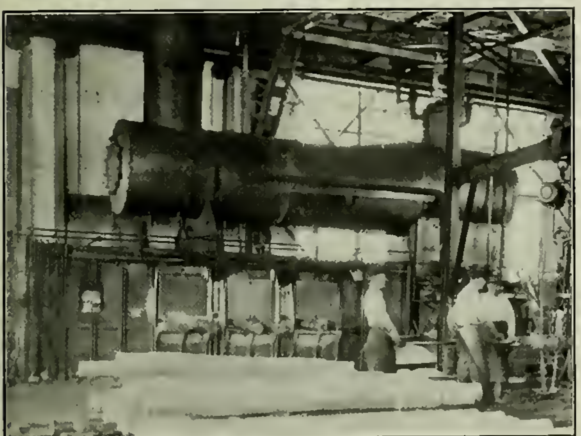
The automatic straight air-brake system mentioned in last year's report, which was submitted by the Automatic Straight Air Brake Co., New York, has been subjected to thorough tests during the year. The brake apparatus was first installed on a 100-car test rack in New York City and an elaborate series of tests was made. These tests demonstrated that the apparatus was sufficiently developed to warrant its trial under service conditions on a road having heavy traffic and mountain grades, and after the rack tests had been completed the brake apparatus was installed on 100 steel hopper cars on the Virginian Railway. These cars were loaded with coal. Standing and running tests were made with trains of 50 cars and 100 cars each, various arrangements of cars equipped with the present types of brakes and the new brake apparatus being used in these trains.

The purpose of these tests was twofold; namely, to determine whether the automatic straight air-brake apparatus would operate synchronously with brake apparatus in common use and to determine whether the new brake could be depended upon properly to control long trains on heavy grades as well as in general service. In these tests synchronous action with brake apparatus now in common use was obtained under a number of varied conditions and circumstances, and the flexibility of the system in controlling long trains, as well as smooth operation and the absence of severe shocks, were amply demonstrated. Many of the intended functions of the brake were substantially accomplished. The more important of these are (1) providing uniform brake cylinder pressure, irrespective of piston travel; (2) compensating for brake cylinder and brake pipe leaks; (3) greater availability of the emergency feature; (4) a graduated release feature, permitting flexibility of control; (5) prompt serial action in application and in release.

SHOP PRACTICE

UTILIZATION OF WASTE HEAT FROM BLACKSMITH FURNACES

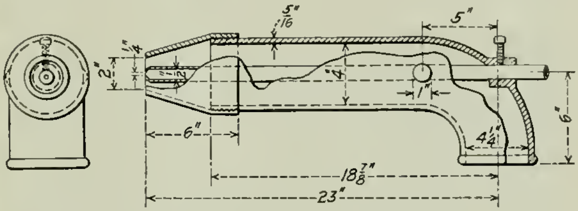
No one who has been around blacksmith shops can have failed to notice the flames from the furnaces rising out of the stacks. This is such a familiar sight that it is taken as a matter of course: but on second thought it is quite evident that the flames must carry away a great deal of heat that has never been utilized. At the same time that this heat is going to waste, fuel is being burned in some adjacent power plant to furnish steam for hammers, shears and blowers in the blacksmith shop. When there is such urgent need for fuel economy, why would it not be well to utilize the heat of the furnaces to generate steam for the smith shops?



Locomotive Boiler Set Over Furnace to Supply Steam to Hammers

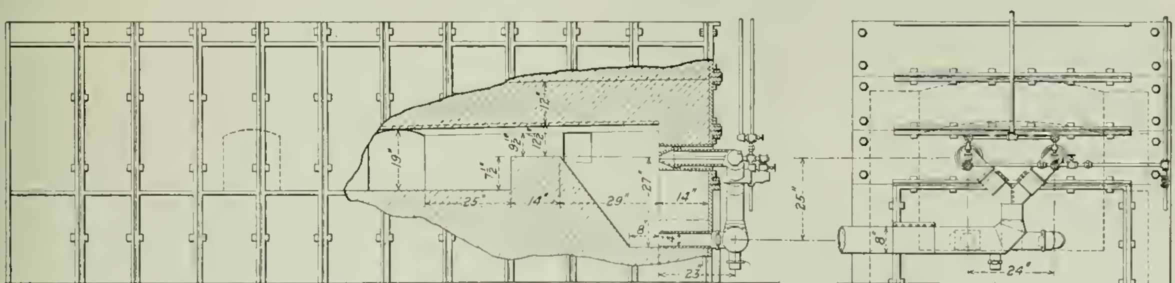
This is by no means a new idea. Boilers mounted over furnaces are to be found in shops built many years ago. The very limited extent to which this practice has been followed in shops recently constructed might lead to the conclusion that it has proved a failure. That such is not the case is fully demonstrated by the operation of the two blacksmith shops of the Atchison, Topeka & Santa Fe at Topeka, Kan. In these shops the heat from the furnaces is used to generate steam in locomotive boilers which supply the steam hammers and also a few steam-driven tools. In the interest of fuel economy in railroad shops, a description of the plant may not be out of place.

The furnaces over which the boilers are placed burn fuel oil. They are equipped with combustion chambers and the furnace proper varies from 8 ft. to 12 ft. in length. A view of the cross-section of the furnace is shown in the illustration. The oil is sent in through two burners in the end under a pressure of about 12 oz. from a fan blast. An auxiliary air supply enters the combustion chamber just below the burners. These burners are also fitted with steam jets which can be used to atomize the oil in case the air supply fails. As an alternative the furnaces can be readily and quickly changed to burn coal. Several features of this furnace are covered by a patent issued to George Fraser, foreman of the blacksmith shop.



Detail of the Furnace Nozzle

The flames from the burner strike directly on the point of the bridge wall of the combustion chamber. This has proved to be a great help in securing a neutral flame. If there is any tendency for carbon to deposit it gathers on the brick-work and not on the iron. After passing down through the neck of the furnace the flame is directed upward into the firebox of the locomotive boiler, through the flues and out the stack. The photograph below shows clearly the way in which the boilers are mounted over the furnaces. Very few changes were made in the boilers to adapt them for this service. They are fed by boiler feed pumps operated by the hammer driver who watches the water level to see that it



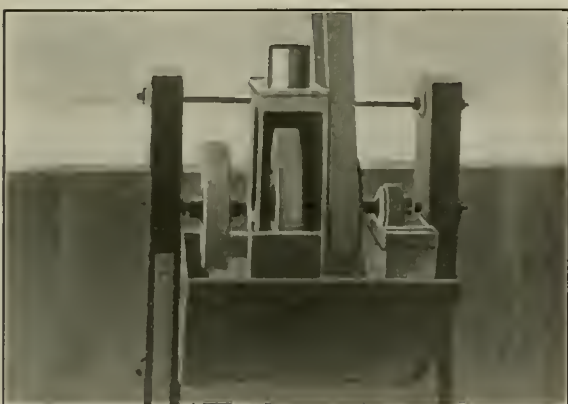
Arrangement of the Furnace, the Waste Heat of Which Is Used for Generating Steam does not get too low. The water glass is situated so that it is always in view of the hammer operator. Steam is taken from the highest point in the dome. All the boilers are connected together; the maximum pressure carried is 100 lb. per sq. in. It ranges generally between 75 and 85 lb. The stacks over the boiler are 75 ft. high without brick lining and have a damper near the smoke box instead of at the top of the stack. In operating the furnaces the blast is varied until a balanced draft condition is secured. This makes it easy to work around the furnace as the flame does not shoot out and work can be put in or taken out without disturbing the burners.

In the blacksmith shop at Topeka there are seven boilers placed over furnaces. These supply steam for 17 hammers, varying in size from 5,000 lb. to 150 lb. There is no other source of steam supply for the smith shop. While, of course, some of the small furnaces are not fitted with boilers or stacks, all of the larger ones are so equipped. The operation is very satisfactory and there is no question that the plant effects large savings in both fuel and money.

RECLAIMING BULL'S-EYE LUBRICATOR GLASSES

After lubricator glasses have been in service for some time the inner surface becomes rough and discolored. A glass in this condition causes difficulty in seeing the oil as it is fed. The Atchison, Topeka & Santa Fe has installed at the Topeka shops equipment for regrinding these glasses to avoid the necessity of replacing them when they become rough. The installation has now been in service for some time and the results secured are very satisfactory.

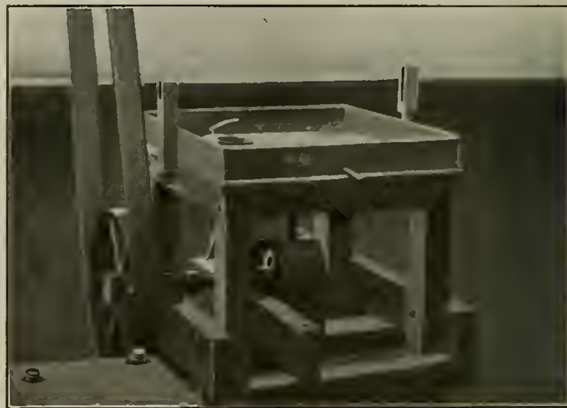
The machines used are quite simple and are shown in the illustrations below. The first grinding is done on a flat cast iron disk about 19 in. in diameter mounted on a vertical



Stone, Felt and Wood Wheels on Which Glasses Are Polished

spindle which revolves at the rate of 200 r. p. m. Sharp sand and water are used on this disk as an abrasive and the glass is ground down until a true surface is secured. A set of three wheels mounted on a single spindle are used for the finished grinding. The first wheel is a black cragleith stone which gives the glasses a smooth finish. The polishing is done on a felt buffing wheel and a willow wood wheel on both of which pumice stone and water are used. The three wheels revolve at about 350 r. p. m.

Glasses which have been scratched or chipped can be reground as well as those that have become roughened or discolored by use. They cannot be ground down below a certain thickness, which is about one inch; for that reason, limit gages are used to determine when the minimum allowable thickness has been reached. In shipping the glasses to the shop where they are to be reclaimed they should be packed in an orderly manner in boxes filled with sawdust. The machines used in reclaiming lubricator glasses are simple and comparatively inexpensive. It does not require



Machine for Rough Grinding Glasses

a very skilled operator to secure good results, and the saving effected at the present price of material is sufficient to justify such an installation on any road operating several hundred locomotives.

LOADING AND GLAZING OF GRINDING WHEELS

In replying to a question as to the relation of the speed of grinding wheels to "loading" and "glazing" Chas. H. Norton writes in "Grits and Grinds" as follows:

Loading is not caused *by* slow speed. It can be caused *with* high speed as well as *with* slow speed, but *is not caused by the speed.* If the wheel is forced into the work so deep and so quick that the material to be ground is crowded into the open spaces, filling them full before the bond can be worn away by friction, the wheel will be loaded, whatever its speed. But in practice it is usually impossible to cause this when the wheel is revolving at high speed, because the higher speed cuts smaller chips when removing an equal amount of metal in the same time. However, it sometimes happens that there is insufficient power to keep the wheel up to its full speed when the operator forces it quickly into the work; it will sometimes be slow enough to cause the particles to tear off chips so large that when they are forced hard into the spaces they will hold the bond in place instead of wearing the bond away.

If the chips are too large for the spaces and are forced into them, the bond cannot wear away because the chips have become the wearing surface, and until these chips are removed the bond must remain, since it is underneath the chips. This is a well known law with files and milling cutters. If a file is forced to the work too hard, it will fill with steel; the same is true of milling cutters.

The cause of wheel loading is not slow speed but *overwork*, whatever the speed. It is more difficult to overwork the wheel at high speed than at slow speed. Therefore, it is more unusual. When wheels are not overworked the slower the speed the faster the bond will wear away. The faster the wheel speed, when not overworked, the slower the bond will wear away and the longer the cutting particles will remain intact. Thus, when the speed is sufficiently high to cause the cutting particles to wear faster than the bond, we get the glazing effect.

Safeguards in Railroad Shops

A Description of Some of the Safety Devices Used at the Various Shops of the Southern Pacific

BY FRANK A. STANLEY

THE application of safeguards for workmen in railroad repair shops involves some elements of difficulty not commonly attached to the installation of safety devices in the general machine plant and factory. In the first place, there is an essential difference in the character of the equipment as a whole in the two classes of establishments referred to and there is, further, an equally important difference in the general method of installation due of course to the peculiarities of the work conducted therein. The recognition now for some years given to the necessity for suitable guards for machine tools and other apparatus has led the builders of this equipment to incorporate many such devices in the design of the machines themselves thus doing away with the necessity for the purchaser to develop a system of safeguards for such equipment. This advance in tool design is naturally more conspicuous in the cases of the smaller and medium sizes of machines.

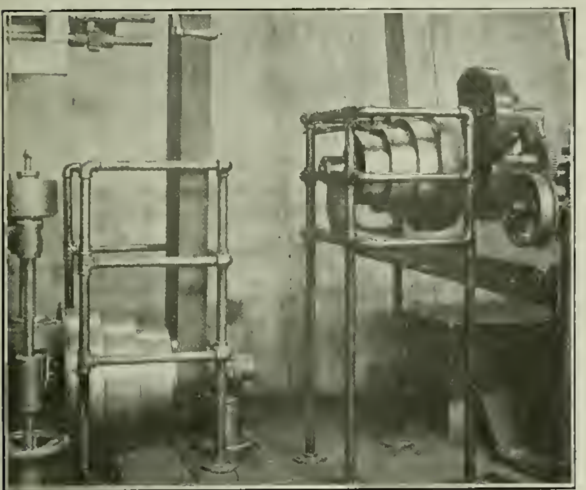


Fig. 1—Pipe Railing for Protecting Belts

With the railroad shop the machine shop proper is only one of several departments where closest attention is constantly demanded if workmen are to be kept free from injury. The erecting floor may be a prolific source of danger unless progressive measures are applied toward protecting the men working about the pits and elsewhere in the department. Outside of the shops, about the yards are various points where safeguards must be erected and maintained, such as railings for washing pits, screens for work undergoing chipping, etc., etc. To be sure, the dangers to the eyes of mechanics about railroad shops is not peculiar to these places, but it does undoubtedly exist in greater degree than in almost any other kind of plant, a fact that has been demonstrated by the necessity for eye protecting goggles in large numbers. These, where consistently adopted, have gone far toward the complete elimination of eye accidents. This can be no better illustrated than by reference to the experience of a conspicuous eastern repair shop which in one recent year prior to the campaign for the adoption of eye protective measures suffered a total of over four thousand injuries of varying degree, which the following year were reduced almost to zero by the adoption of goggles which the men were forced to wear when working at points of danger to the eye.

WHAT ONE SYSTEM IS DOING

Certain characteristic features of the Safety First campaign in the way of safeguards developed and adopted in different shops of the Southern Pacific are shown in the illustrations that follow. These include machine guards, for shop and wood working departments, yard safety devices, appliances for minimizing possibilities of accidents about the erecting pits, and so on.

The guards in Fig. 1 are for enclosing the driving belts and pulleys of two machines; the one at the right a shaper, the other a vertical boring mill. In both instances the railing is made of piping extending to a height that will effectively prevent any likelihood of a passing workman catching his clothing in either the belts or pulleys. The pipe enclosures are stiffly constructed and with machines placed with their driving cones and belts in fairly close position in respect to each other this form of guard is of especial advantage as it in no way interferes with the convenient shifting of belts on pulleys.

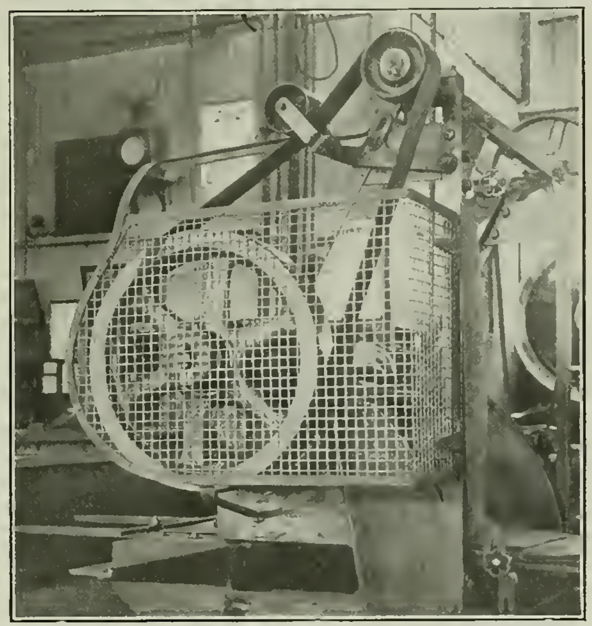


Fig. 2—Hinged Guard for the Fly Wheel of Copper Shop Shears

The guard in Fig. 2 is a hinged screen for the flywheel and driving belt of a shear in the copper shop. A guard of similar pattern is used over the pulley of the sprue shears used in the brass foundry. Another foundry guard is shown in Fig. 3 which shows a row of grinding wheels ten or a dozen in number, all protected by heavy plate covers which nearly surround the wheels. The frequency of serious accidents from unguarded wheels is too well known to require discussion here. The type of guard shown prevents broken wheels from flying across the shop and while protecting the workman from injury it in no way hampers his use of the wheel. Wheel covers of this kind are readily made in such shops from available material and they are easily proportioned to conform to the dimensions of the grinding wheels employed on the floor stands.

Special guards are erected on heavy lathes for enclosing

Fig. 3—Guards for Grinding Wheels

the feed drive at the end of the bed and the back gears at the rear of the spindle. The end guards are made up of a coarse wire screen riveted to a steel angle frame which is of sufficient size to extend from the base to the top of the head stock. The sides of the guard are wide enough to completely

Fig. 4—Protected Motor and Belt in the Pattern Shop

close in the feed cone and belt at the front and there is no possible way in which the operator's hands or clothing may become caught in the mechanism. The guard for the back gearing is made of sheet steel covering completely the gear teeth and extending well down over the faces of the gear wheels. Both guards are hinged to give ready access to the interior when desired.

In order to properly protect the operator from being injured by the rapidly revolving bar stock extending out from the spindle of turret lathes, a system of small pipe guards has been arranged. There are six longitudinal rails extending out from the machine, being supported by pipe standards from the floor, which completely surround the revolving rod.

APPLICATIONS IN WOODWORKING DEPARTMENTS

Referring now to some of the protective devices installed in the woodworking shops, Fig. 4 illustrates the application

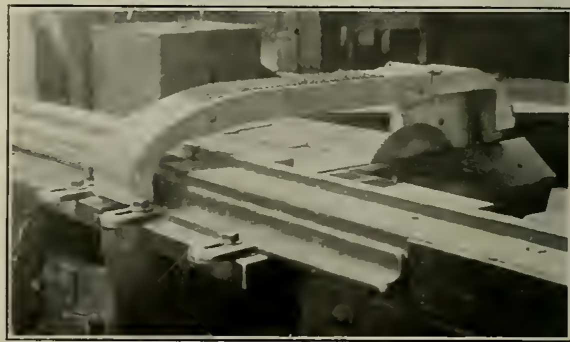


Fig. 5—Draw Cut Saw Guard in the Cabinet Shop

of a guard rail system and swinging screen gate for enclosing a motor and belt in the pattern shop. The belt here is run at an angle of about 45 deg. to the overhead shafting, and in

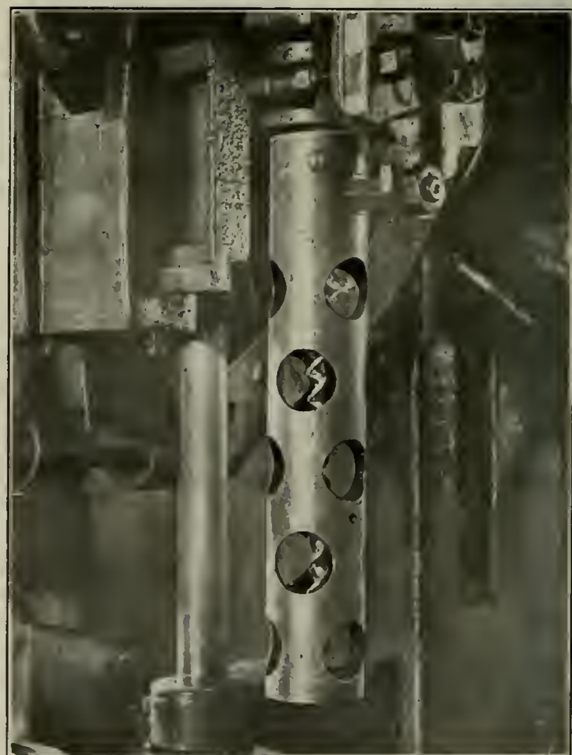


Fig. 6—Wood Boring Bit Guard

this position, if unguarded, it would be a constant menace to those obliged to pass under it. The lower portion of the belt is surrounded by the high pipe fence which is built around the motor. The remainder of the belt for a height of, say, seven feet is paralleled by a sloping guard which just clears the underside of the belt and which has at each side a pair of rails to provide protection along the belt edges. The enclosure

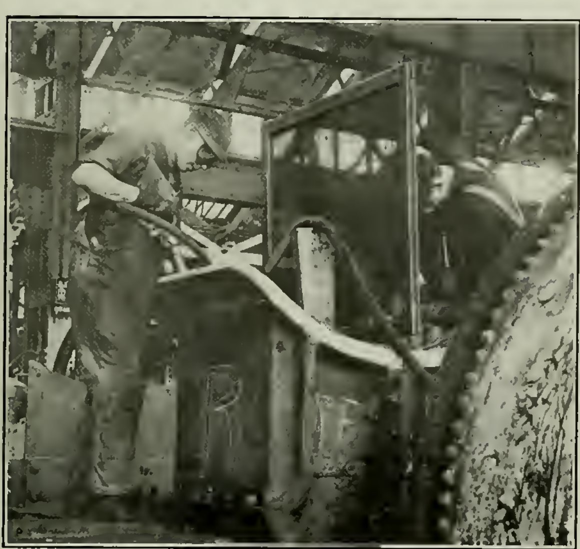


Fig. 7—Protecting Screen Between Men Clipping Cylinder Saddles. Note Also the Goggles

for the motor itself is formed on the front side by the wire gate which swings open when unlocked to give access to the machine.

Saw guards are generally provided and require little explanation. Fig. 5 shows a guard for a circular saw in the cabinet shop. Another feature of this department is the use of a rubber mat in front of the saw which is placed here to prevent the workman from slipping while he is operating the saw.

An interesting form of guard for a wood bit used in the mill shop is shown in Fig. 6. This safety appliance consists of a steel tube containing a number of holes through which the chips may work out when boring. The tube is located over the spindle which carries the bit and is attached to a bracket by which it is prevented from rotating, and by which it is moved up and down. It encloses the bit at all times, and when the bit is at work boring through the wood the chips are ejected from the tube through the liberally placed holes shown in the illustration.

SAFEGUARDS ABOUT THE ERECTING FLOOR

Reference has already been made to the necessity for protective goggles in railroad shops. A still further measure of protection, and one almost as valuable as the goggles themselves is the adoption of the portable wire screen which, as in Fig. 7, is placed at any convenient point to prevent chips made by one man from striking another nearby. This scheme can be developed further in the yard where chipping or cutting rivet or bolt heads is done, by making a portable screen with a substantial base which will prevent the chips or heads from flying about. Still another device used for stopping metal parts that would otherwise fly to a considerable dis-

Fig. 8—Pipe Connections Placed at an Angle Away from the Operator When Making Connections

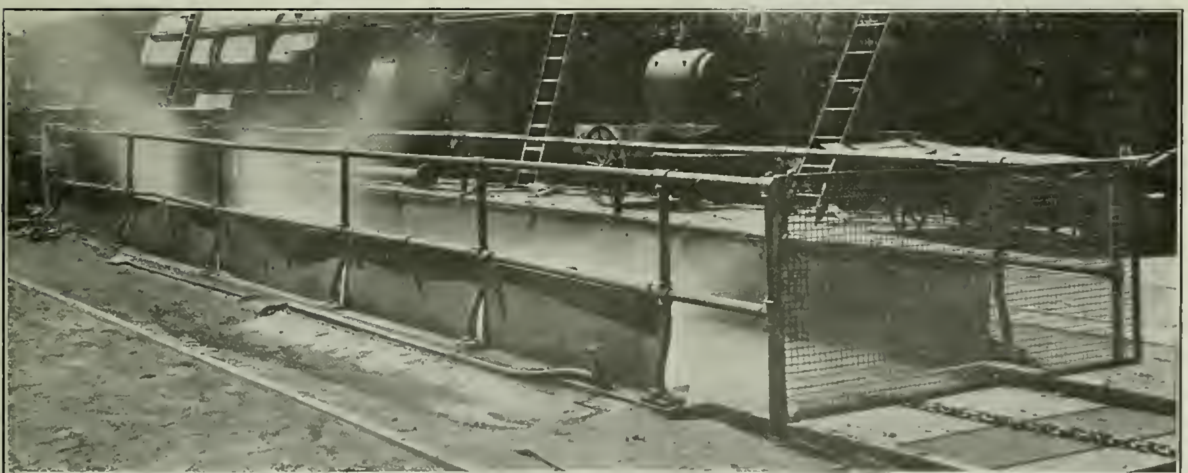


Fig. 9—Safety Railing Around the Lye Pit

tance is the wire basket which is held under rivet heads which are being cut off by hand chisel and sledge.

One of the unsatisfactory features of many erecting floors is the system (or lack of system) of steps, ladders and stagings for enabling the men to climb about the ends and tops of boilers and fireboxes. Not only are the makeshift rigs often dangerous to those obliged to use them, but they are to an equal extent the cause of lost time and effort. In this shop a portable stairway which is a substantial and reliable structure, has proved very effective in saving time and trouble. It is equally applicable to the front, end or sides of the locomotive.

Another interesting safety measure adopted at this shop is that, as shown in Fig. 8, of setting the floor hose connections at an angle so that they do not blow directly in the face of the operator when connections are being made.

Fig. 9 shows a substantial safeguard for a large lye pit. This has, in addition to the two-high pipe rail an end gate which swings open to allow the dipping cars to be run in and out with the material to be washed. Along each side the space under the lower rail is enclosed by sheet metal as indicated in the illustration.

AIR BRAKE DEVICES AT BRAINERD SHOPS

The Northern Pacific does a large amount of air brake repairing at the Brainerd, Minn., shops. In order to expedite the work, many special devices have been developed, a few of which are described below. One of the most useful tools in the air brake department is the machine for grinding the bushings of triple valves shown in Fig. 1, which was

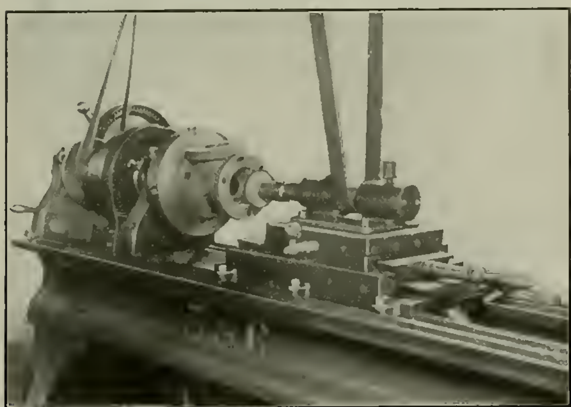


Fig. 1—Lathe Arranged for Grinding Triple Valve Bushings

made from an old brass lathe. In ordinary service the pistons of triple valves move principally between service and release positions and this causes the ring to wear the bushing through a small portion of its length. When triple valves are repaired at Brainerd shops the bushings are ground on this machine to make them truly cylindrical. The body of the valve is attached to a removable face plate which can be centered by means of screws. The grinding wheel is mounted on an extended spindle, carried on the cross slide and driven from an overhead counter shaft. By centering the bushing, setting the wheel to take a light cut, and moving it back and forth while the body is slowly revolved, the bushing can be made true and smooth without removing any more metal than is necessary. By changing face plates the machine can be adapted to any type of lathe. The uneven wear of bushings is the frequent cause of irregular action in triple valves and a machine for grinding them should form part of the equipment at least in the larger shops.

Another useful device for repairing triple valves is a press for closing the grooves in the piston shown in Fig. 2. The base is made of cast iron with a hole through the center and a counter-bored recess at the top. The bottom die is placed in the recess and the piston is set on it with the stem extend-

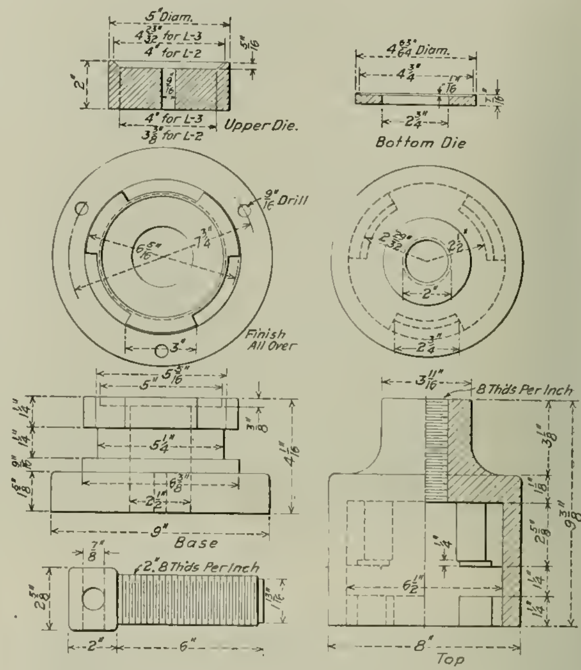


Fig. 2.—Press for Closing Triple Valve Piston Ring Grooves

ing down into the base. The upper die is placed on the piston and the top is set over it and turned to lock it to the lugs on the base. By turning down the screw in the top the

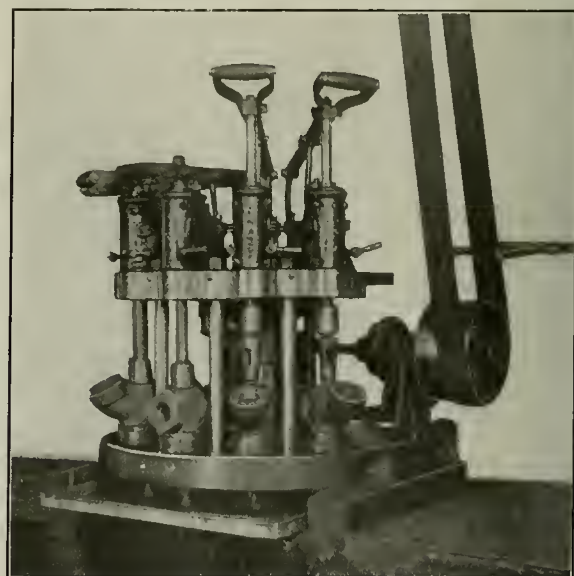


Fig. 3—Five Spindle Angle Cock Grinding Machine

piston can be compressed and the grooves closed. It has been found that the operator soon becomes skilled in using this device so he can get a good fit in a very short time. The dies shown in the illustration are the sizes used for *L*-2 and *L*-3 triple valves.

The angle cock grinding machine shown in Fig. 3 was originated on the Northern Pacific. It is convenient to operate and grinds the cocks very rapidly. The plugs are fastened to five vertical spindles which are revolved and reversed by a segmental gear. At the same time a trip lifts the plug from the body at regular intervals. The spindle can be raised by means of a handle and when at the top point it is thrown out of gear and held by a latch so that the bodies and plugs can be changed without stopping all the spindles. One of the excellent features of this machine is that the grinding compound is kept away from the gears and bearings. As many as 300 angle cocks have been ground in one day.

Oxy-Acetylene Welding Problems*

Discussion of the Flame Structure and Methods of Handling; Careful Training of Operators Necessary

BY W. L. BEAN
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It is my desire to present certain phases of the oxy-acetylene process which may have escaped the attention of those who have not had opportunity to study it in all its details. The use of the process in railroad work alone has grown since 1912 fully 25 times in volume. Methods of handling and applying oxy-acetylene in railroad work should, however, be scrutinized and properly supervised if the results are to match up with the rapidly mounting expenditures necessary daily, and monthly, and yearly to carry on the work. Since the process depends on two gases, acetylene and oxygen, a few facts, with respect to each, may be mentioned, I trust, with interest and profit.

Acetylene

Acetylene, which, as is known by all, is generated by chemical reaction between water and calcium carbide, is a gas of remarkable qualities. Briefly, its most outstanding characteristic, and the one which puts it head and shoulders above all other commercial gases, is its high carbon content which is 92.2 per cent of its total weight, and which gives such a high flame temperature, especially when burned with pure oxygen. Furthermore, the endothermic nature of acetylene further increases the flame temperature.

It is this characteristic which prevents the common gases, such as ordinary illuminating gas, natural gas, benzine, gasoline, kerosene, Pintsch and Blau gases, etc., from competing with acetylene for welding any metals, but those with low fusing temperatures; and from cutting steel or iron with the greatest economy. Comparative temperatures attained by burning acetylene and other fuels supplied by air are shown by the tabulation below:

Fuel Gas Flame—Temperature in Air

Alcohol	3,092 deg. F.
Marsb gas	3,362 deg. F.
Hydrogen	3,452 deg. F.
Coal gas	3,542 deg. F.
Water gas	3,632 deg. F.
Acetylene	4,652 deg. F.

Naturally when flames are supported by oxygen instead of air, the temperatures attained are much higher. This is of interest because it is sometimes difficult for those in charge of oxy-acetylene work to understand why it is necessary to use oxygen instead of air for welding work:

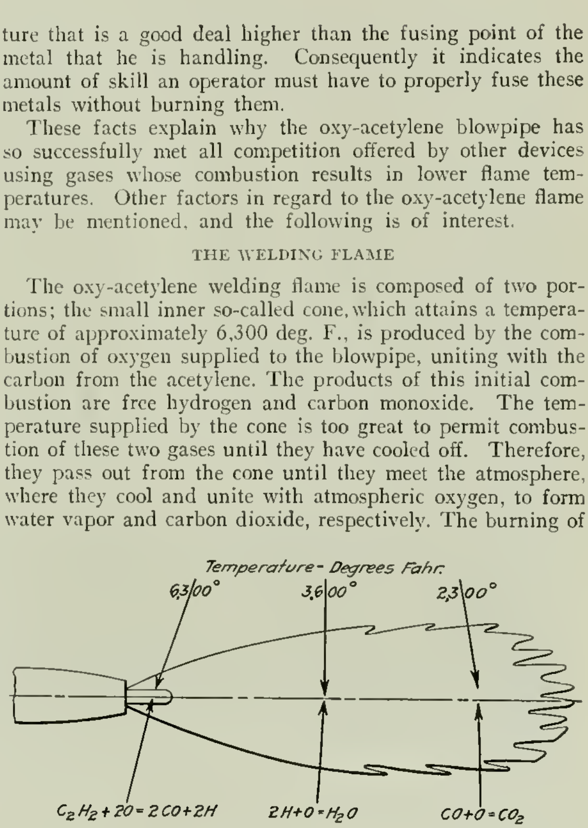
Coal gas burned in oxygen	3,960 deg. F.
Hydrogen burned in oxygen	4,388 deg. F.
Acetylene burned in oxygen	6,300 deg. F.

It is to be noted that acetylene burned in air gives a higher flame temperature than either coal gas or hydrogen burned in oxygen. My object in bringing up this subject of flame temperatures is to show that a welder handling a blowpipe has an extremely hot flame to handle; a temperature that is a good deal higher than the fusing point of the metal that he is handling. Consequently it indicates the amount of skill an operator must have to properly fuse these metals without burning them.

These facts explain why the oxy-acetylene blowpipe has so successfully met all competition offered by other devices using gases whose combustion results in lower flame temperatures. Other factors in regard to the oxy-acetylene flame may be mentioned, and the following is of interest.

The Welding Flame

The oxy-acetylene welding flame is composed of two portions; the small inner so-called cone, which attains a temperature of approximately 6,300 deg. F., is produced by the combustion of oxygen supplied to the blowpipe, uniting with the carbon from the acetylene. The products of this initial combustion are free hydrogen and carbon monoxide. The temperature supplied by the cone is too great to permit combustion of these two gases until they have cooled off. Therefore, they pass out from the cone until they meet the atmosphere, where they cool and unite with atmospheric oxygen, to form water vapor and carbon dioxide, respectively. The burning of



Temperatures in the Oxy-Acetylene Torch Flame

the hydrogen to create water vapor is at about 3,600 deg. F., and the carbon monoxide burns forming carbon dioxide at about 2,300 deg. F. That is of particular importance in welding alloys or metals like copper, which oxidize pretty rapidly, and it is one feature that stands out in favor of the oxy-acetylene flame as compared with the electric process, for although the electric process has the advantage of generating a great deal less heat—and thus reducing contraction stresses—the metal is not protected from the atmospheric oxygen as it is with the oxy-acetylene flame. The outer, cooler, enveloping flame acts as a shroud, which keeps the atmospheric oxygen from uniting with the metals being welded, thereby performing a valuable work. The products of the combustion, which forms the cone, hydrogen and carbon

*Abstract of a paper presented before the New England Railroad Club.

monoxide have strong affinities for oxygen, thereby assisting in preventing any excess of oxygen from uniting with the metals.

These features all contribute to making the oxy-acetylene blowpipe the wonderful device that it is, and the subject of flame temperatures is dwelt upon here with the practical consideration always in mind that the successful operator and his supervisor should know these elementary things in order to properly handle their work. If the operator does not know them, he will, with the best of intentions, spoil or render inferior most of his welds, and his supervisor may stand by and watch and not know what is going on because he cannot recognize what he is looking at. Examination of hundreds of test specimens and likewise hundreds of observations of welding operations convincingly shows that the great majority of blowpipe operators underheat the body metal; that is to say, the piece being welded, and, on the contrary, they overheat the wire or filler metal. An operator who plays the small cone directly on the filler wire is burning it. He cannot do otherwise. Such a workman invariably runs the burnt metal upon the underheated surface of the piece he is trying to weld, and gets an adhesion, but not a weld. He has, as a result, a combination of two weak elements; viz., burned metal attached by surface adhesion to the body metal.

This point cannot be too strongly emphasized, as it is the cause of more inferior welds than any other one thing. The skilled operator works the end of his filler wire in a puddle of the metal, agitating the molten metal and thereby distributing the heat. Also, he constantly moves his welding cone so as not to overheat the molten metal and so as to permit moving the wire through the latter without the wire encountering the welding jet. The welding cone should approximate, in its movements, a half circular arc. The welding wire should be melted by heat from the puddled metal plus radiated heat from the cone, but never by being enveloped by the latter. The function of the acetylene in cutting, being merely to raise the metal to the temperature where the oxygen can take hold of it, has led a good many to attempt to use as a substitute a cheaper gas than acetylene, but because of the high flame temperature of the acetylene—consequently the ability to localize the heat in a relatively small jet—there is really more economy in paying the higher price for acetylene—that is, economy in oxygen—than there is in using other fuel gases, even though the other gases cost nothing.

OXYGEN

The development of the oxy-acetylene process was retarded by the high price of oxygen. In 1910 oxygen was commonly sold at from four to six cents per cubic foot and still largely produced by the potassium chlorate process. The big possibilities commercially, however, stimulated production and a cheaper chemical process using bleach powder and some other reagents had a short life, the cost being about 2½ cents per cubic foot. The electrolytic and liquid air processes, however, control the market at present and are likely to continue, especially the latter. In 1912 the price of oxygen had dropped to about 2 to 2¼ cents per cubic foot, in quantities, and now most railroads buy it for 1½ cents or slightly less. Therefore, it is one article of importance which has decreased in price during the period of the war, and, as it is the item of largest expense in welding, especially in cutting operations, railroads have a better opportunity than ever before to make large and profitable utility of the process. It is true that carbide has increased in price, and so has labor, but not more than like items entering into costs of doing work or reclaiming materials by other methods.

APPARATUS SELECTION

Naturally with the development of the process there comes opportunity for refinement in the selection of apparatus to suit given conditions and the ultimate results depend on the choice made.

For oxy-acetylene operations in small shops or for temporary work at remote points, compressed acetylene in portable cylinders is best adapted to the work; but in large shops, where a relatively large amount of work is done regularly within a restricted area, full advantage should be taken of the economies of stationary apparatus connected to a piped system. Experience indicates that railroad shop installations of oxy-acetylene equipment should consist of stationary instead of portable apparatus when the volume of welding and cutting requires the services of two or more operators regularly.

Compressed acetylene costs 1½ to 2 cents per cubic foot, f. o. b. charging station. Freight or express charges must be borne by the railroad both on the filled and the empty drums, whereas, in using a generator, the cost per cubic foot is ¾ to 1 cent per cubic foot, depending on carbide price, and there is no expense for transportation except in one direction, and also there is less weight to be handled per foot of gas delivered by the generator as compared to the compressed acetylene. Also the slowness of releasing the compressed, or dissolved gas, especially on heavy work, causes operators to set cylinders aside as empty when they still retain from 10 to 20 per cent of the *nominal gas charge.* This is especially true in cold weather. This feature, of course, raises the cost of the gas per actual cubic foot delivered to the blowpipe. The cost is also affected by the admixture of varying amounts of acetone to the discharged gas.

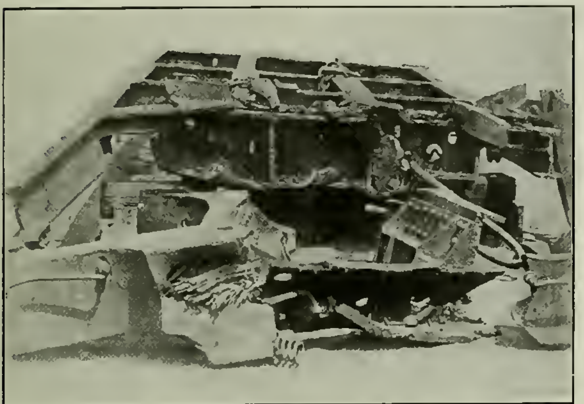
Acetone, by reducing the flame temperature, requires the burning of more acetylene to do a given amount of welding

Repaired Cast Steel Tender Underframe

than is needed when acetylene, free from acetone, is taken directly from a generator. These several features combined produce an actual cost for compressed acetylene of 2½ to 3 cents per cubic foot.

Aside from the above considerations, there remains a number of matters concerning ease and efficiency of operation. When an acetylene generator is installed, it delivers a continuous supply of gas to a shop through a pipe line at a constant pressure, thereby eliminating the need of regulators or reducing valves which have the following disadvantages: First cost, maintenance cost, and the time required for adjusting pressure and for connecting and disconnecting from cylinders.

Under the constant supply system the operator is at once relieved of all concern as to gas supply, since the handling



A Wrecked Cast Steel Tender Underframe Repaired by Oxy-Acetylene Welding

of cylinders from the storehouse to the shop and back again, and from job to job, is eliminated. He is also not concerned with regulating the gas pressure, as that is done by the generator, and he need not, and, in fact, cannot, change the pressure. That cuts out the regulator expense and annoyance. In fact the operator has his hose and blowpipe and can move from job to job without any more apparatus to carry or adjust than in the case of a man using an air hammer supplied by a pipe line.

Blowpipes are carefully designed by manufacturers and should not be altered by railroad shop men. If orifices are changed the proportion of mixing of oxygen and acetylene is disturbed with consequent effect on combustion. In this connection it is important to point out the need for using gas pressures and welding and cutting nozzles suitable for the heaviness of the work done. The average railroad shop worker, and that includes foremen, generally assumes that if a little is good a whole lot more is better, and so, one can daily observe operators welding thin plates with cones big enough for a locomotive frame job, or cutting an ash pan sheet, with 75 lb. oxygen pressure instead of 25 lb. Likewise, in using a cutting blowpipe, too large nozzles are used. When one cuts a ⅜-in. plate with 75 lb. oxygen pressure and a nozzle to match that pressure, fully two-thirds of the oxygen is absolutely wasted and the cost increased at the rate of $4 to $6 per hour of operation. There is a lot of money being wasted in everybody's railroad shop, especially on cutting, by using nozzles and pressures that are too big for the job, and a lot of alleged savings that are going by the board on that account.

There must be education and real supervision along these lines, or else the volume of poor and at the same time expensive work cuts down the benefits deplorably, below what they should reasonably be. The average net savings in money, in ordinary locomotive and car shop work, should conservatively and easily average $1 per blowpipe hour.

Of course, not all jobs of work are, or should be done by oxy-acetylene, solely to secure a reduction in first cost. The better quality of a welded job with longer life and less trouble in service, may warrant spending more money welding it than to do it in some other way. For example, some shops can rivet firebox seams cheaper than to weld them, but they find it pays to weld. Hence, the back shop saving in money does not tell the whole story. Likewise, all are familiar with large savings in time consumed by repairs whereby equipment has been released for service more quickly than otherwise possible.

I would like to speak of a job that the men on the New Haven did this summer on a Commonwealth tender frame for a Santa Fe type engine. Just after those engines came one of them got into difficulty with another one, and when the dust had all settled there was about six or seven feet of each end of the Commonwealth frame that was pretty well pulverized. The frame was taken to the shop. I don't need to dilate on the possibilities of last June in getting a frame of that sort from the foundries—at East St. Louis, I believe they are. It looked as if that engine was going to be tied up for the rest of the summer. But the job of welding these broken members was tackled. In addition to the broken portions on the ends the balance of the frame had a nice gentle wave to it, just like a warped board, and you can all appreciate what a job it was to pull that thing back into line. It had to be done by cutting the members to limber it up enough, so that the balance could be bent and the frame straightened, and then these cuts rewelded. Such portions of the damaged ends as could, were rejoined one to the other, and in some places, where they were about the size of a piece of cake, we had to fill in with plates shaped to fit. As I recall, the job altogether took about six weeks' time, and it cost about the same as a new frame, but the engine was in service probably two or three months earlier than would otherwise have been possible, and so we felt it was worth while.

IMPORTANCE OF WELDING ACCESSORIES

Boilermakers know that it would be folly to build a fine locomotive in all particulars except the firebox, and then to make the latter out of tank steel, or to build the engine according to approved practice and then put in staybolts made of common merchant bar iron. Just as unwise is it to equip a shop with high-grade oxy-acetylene apparatus and then give welders common iron to use as "filler" metal, or to set them to welding a gray iron casting with scrap packing rings for "filler."

The different metal parts of a locomotive vary greatly in their chemical and physical characteristics, and likewise those characteristics usually change more or less when the metals are heated to a welding temperature. On that account "filler" metals and fluxes designed to produce metal in the weld as nearly as possible of the right make-up should be used.

Charcoal iron wire of great purity is best for firebox work, and no flux is needed, but it is not the best practice to weld a cast-steel mud ring with that metal, which has 48,000 lb. tensile strength, when the mud-ring steel probably has a strength of from 60,000 to 75,000 lb. per sq. in. Is it not better to use on such work a "filler" of proper carbon content to give the weld high tensile strength, and to be otherwise specially adapted to the work?

It is not sufficient to use a "filler" of the same grade as the metal to be welded, or to use one which might seem even better in quality than the object to be welded. For example, any cast iron to be found on a locomotive, no matter how good it may be for the purpose it was made, does not make a good "filler" on a casting where it is important to get a clean, strong weld, which works well under a tool. The reason is, that on cast iron work a special alloy "filler" iron containing from three to four times as much silicon as is found in ordinary foundry castings, is needed. The excess silicon replaces that of the welded casting, oxidized in the making of the weld, and since the silicon controls, to a large extent, the proportion of combined and free carbon in the casting, it cannot be removed without hardness resulting.

A great majority of railroad shops have generally indifferent results in welding cast iron, even where they use approved practices insofar as blowpipes, skillful welders, proper fillers and fluxes, etc., are concerned, because they don't take the proper care in preheating and annealing. It is necessary on a cylinder job, for instance, or any job of any magnitude, where the casting has any complication to it, or any great mass, to heat it slowly, and weld it, and then let it cool slowly. It may be necessary even to let the job stand for 48 or 60 hours covered up from the air to let it gradually cool down. If it is allowed to cool rapidly it will not only warp but it will be as hard as flint. I find that the foremen as a general rule are so anxious to hurry the job that they lose time or lose the weld by not being willing to let the men on the job take the requisite time to do it,—and I don't mean time in the welding itself but in getting ready and in letting the thing cool down slowly afterward. Oxy-acetylene welding, to be carried on with the best of success, must include the use of "fillers" and fluxes specially compounded to meet the needs of the different metals to be welded. This applies to all forms of iron and steel, forgings, plates, shapes and castings; and to copper, brass, and aluminum.

SELECTION AND INSTRUCTION OF WELDERS

The use of pure gases, efficient blowpipes, and proper fillers and fluxes does not insure good welds unless operators are competent. Probably more failures of welds have resulted from unskillful and unintelligent craftsmanship than from any other one cause.

Not all proposed operations of welding are possible or advisable, but when men of some mechanical skill and knowledge of the metals and the demands which service will place on the weld are given correct and sufficient instruction, a great variety of jobs can be done successfully from every standpoint. The principle that years of apprenticeship are necessary for the training of boilermakers or machinists, and but three days or a week should be ample for a welder, has prevailed in some quarters and does yet, although the logic is not clear, and surely is not borne out in practice.

Those railroad men who recognized at the start the value of the oxy-acetylene process and who persistently applied intelligence and ingenuity to the problems attending its use achieved much success, and to those men much credit is due for proving beyond argument, by long records of welds in service for years, that the process is peculiarly adaptable to locomotive and car repairs. Those gentlemen know what constitutes real welding, and what intelligence, skill, and practice is needed in the make-up of a good operator.

On account of the fact that results in welding are very largely dependent on the skill of the operator, and because the welds can vary even more in actual structure than in external appearance, it is necessary to place blowpipes in the hands of men who have a knowledge of the particular piece being welded, as to its physical nature and the service to which it is to be subjected. Moreover, men who can be successfully instructed in the elementary chemistry of the subject will have a finer appreciation of the need for careful blowpipe regulation, the preparation of the work, the use of fluxes, the application of suitable special filler materials, the effects of expansion and contraction, and all other details which have to do with the efficiency and economy of the operation.

Men who are intelligent, who take a natural pride in workmanship, who are uniform in disposition, who are anxious to become proficient, should be the ones entrusted with the blowpipe, and the additional wages which such men command will prove a most excellent investment.

LOCOMOTIVE ELECTRIC HEADLIGHT WIRING

An interesting and well-arranged method of wiring locomotives for electric headlights has been developed by the Pennsylvania Lines West in connection with the electric headlight program on that road. Every effort has been made to provide a system which is free from the possibility of short-circuits and which will occasion the least amount of trouble when a locomotive is being stripped for repairs. The generator is located just ahead of the cab, a steam connection being made from the blower line through the cab with a union joint just outside of the cab.

Three classes of service, namely, road, shuttle and yard service, are provided for. Fig. 1 shows the general arrangement of the wiring and fixtures for locomotives in shuttle and yard service. These are similar to the arrangement for locomotives in road service with the exception of the wiring to the tender, which is eliminated. Fig. 2 gives the wiring diagrams for the three classes of service. They are fundamentally the same. The diagram for locomotives in shuttle service is different from that of the diagram for locomotives in road service in that it provides for the headlight and classification lamps for the tender. The diagram for yard service is different from the diagram for shuttle service in that no dimmer resistance is required. The circuits are controlled by single-pole push

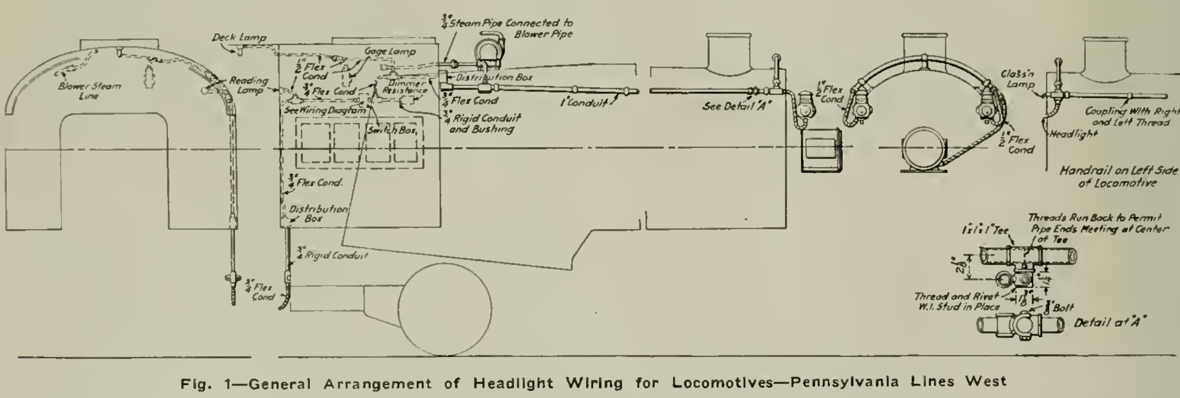


Fig. 1—General Arrangement of Headlight Wiring for Locomotives—Pennsylvania Lines West

button switches which are located on the side of the cab within easy reach of the engineer. For road service three switches are provided. The top one is the main operating

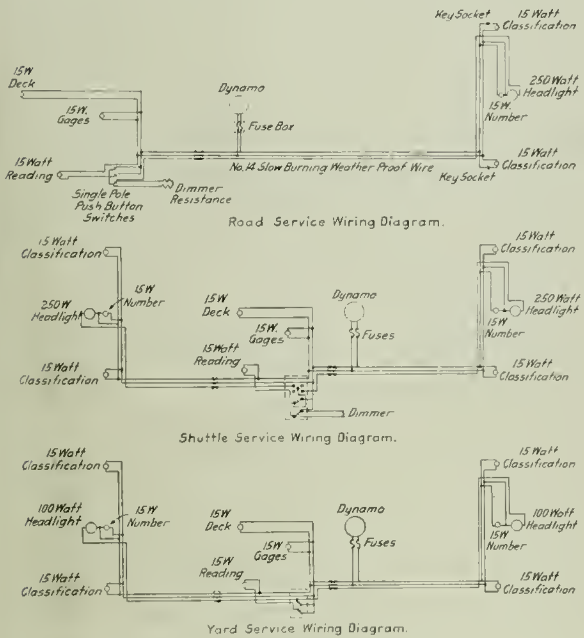


Fig. 2—Wiring Diagrams for the Three Classes of Service

switch energizing the entire system. The middle one governs the circuit to the reading lamp, which is located on the side of the cab back of the engineer. The lower switch throws the dimmer resistance in or out as required. This provides a very convenient arrangement and eliminates any possibility

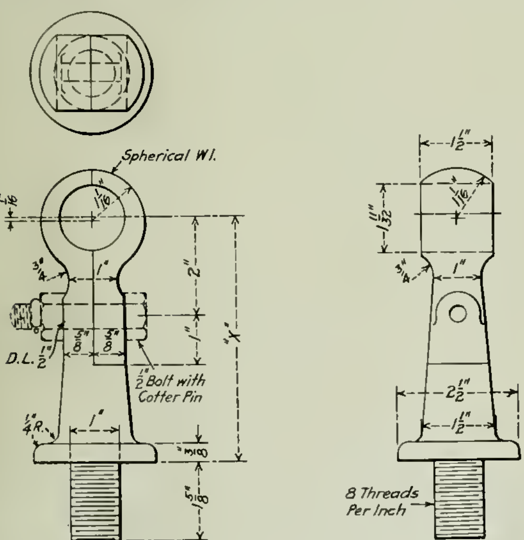


Fig. 3—Details of Hand Rail Column

of the headlight being thrown out of service by mistake when it is desired to cut in the dimmer resistance. It will be noted that a key socket is provided at the classification lamps. This is done for the purpose of insuring proper inspection of the lamps when it is necessary to turn the lights on or off. The deck and gage light, together with the headlight and number light are on the main circuit and are always lit whenever the circuit is closed. They are wired in parallel so that the failure of one light will not break the main circuit.

The wiring diagram for locomotives in shuttle service is substantially the same as that for road service with the exception that the main switch is of the "one-off, two-off electrolier" type, in order to require only one dimmer resistance

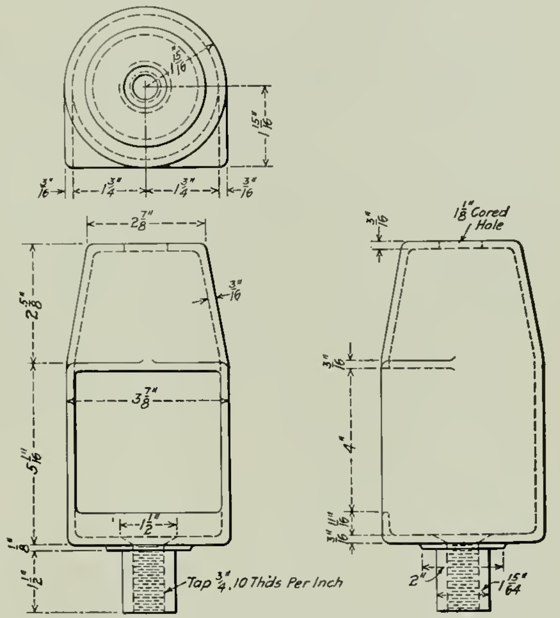


Fig. 4—Cab Lamp Used on Pennsylvania Lines West Locomotives

for both front and rear headlights and still permit them to be wired in parallel. The wiring diagram for locomotives in yard service is similar to that for shuttle service with the ex-

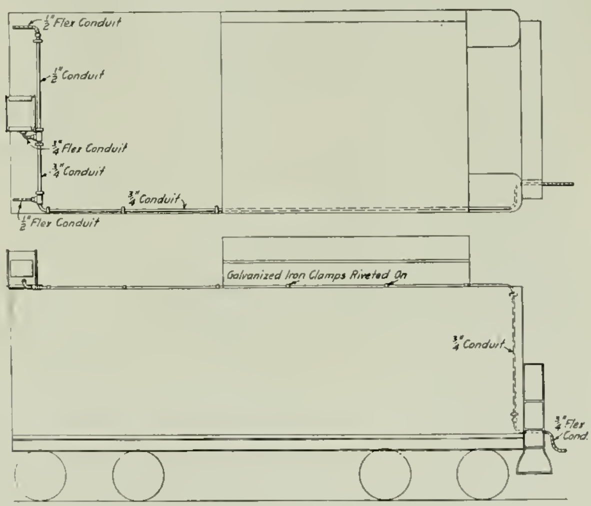


Fig. 5—Arrangement of Wiring on Locomotive Tender

ception of the dimmer resistance, as headlights for this class of service are of less intensity than those for road service and no dimming of the light is required.

The entire wiring is well protected from abrasion and chances of short-circuiting by a double sheathed conduit where it is exposed. The leads from the generator pass through a fuse box into a cast iron condulet, from which they pass back to a distribution box on the outside of the cab and forward through the handrail to the front of the locomotive. It is to be noted that condulets are provided at both ends of the handrail in order that the connections may be easily broken when stripping the locomotive. In fact, this principle has been followed throughout the entire system. It is also to be noted that the handrail columns have been modified. The column is split, as indicated in Fig. 3, to permit the easy removal of the handrail with the wires intact. At the front of the locomotive the wiring passes from the condulet to the right-hand classification lamp and also over the top of the boiler through the handrail to the classification lamp on the other side and to the headlight and number plate, one-half inch flexible conduit connecting the headlight with the condulet. The locomotive distribution box is of a design particularly adapted to the service and is made by the Central Electric Company. This box is attached to the front of the cab, the wires from inside and outside the cab terminating there, there being suitable connections for the wires. When it is desired to remove the cab from the locomotive the wiring both in the cab and on the locomotive can be left intact, the only operation necessary being that of disconnecting the locomotive wires from the distribution box. The cab wiring is run through flexible conduit attached to the roof of the cab. The cab lamp, which is shown in Fig. 4, is made of cast iron and it is held on a cast iron arm which is fastened to the backhead of the boiler and so located as to permit the rays of light from the lamp casing striking the water glass and gages. Only one lamp is used to illuminate the backhead of the boiler. The deck light has a spring grip socket and is located on the roof of the cab. The reading light, as stated before, is located at the side of the cab directly behind the engineer. On locomotives for shuttle and yard service the wiring passes through a ¾-in. flexible conduit down to the bottom of the cab where another distribution box similar to that at the front of the cab is located. The wires between the locomotive and tender pass through a ¾-in. flexible conduit up the side of the tender on the inside, and back to the light at the rear of the tender, as indicated in Fig. 5.

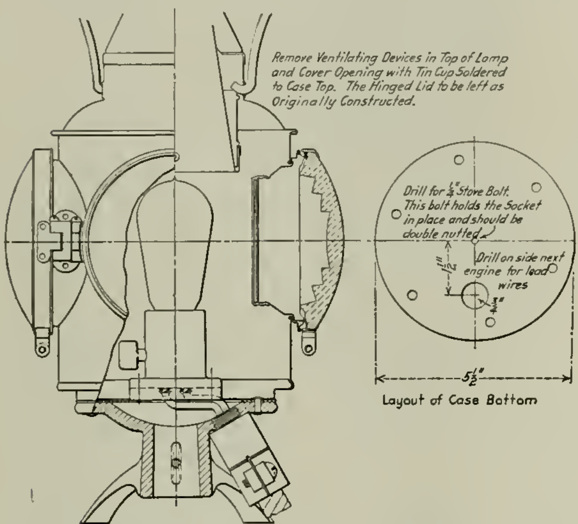


Fig. 6—Arrangement of Classification Lamp for Electric Lighting

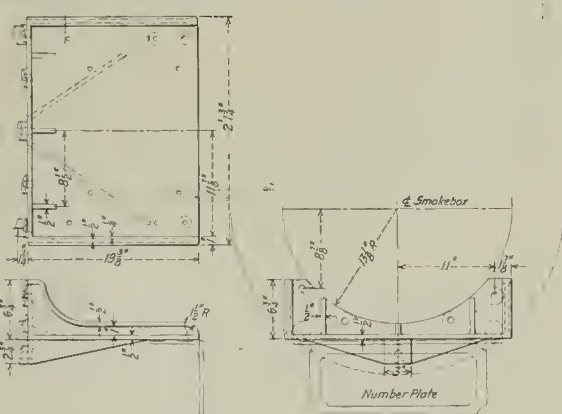


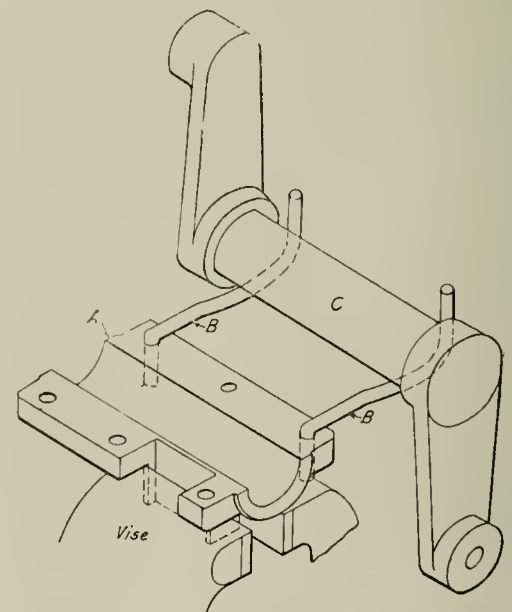
Fig. 7—Bracket for Locomotive Headlight

It was found necessary to make some changes in the construction of the classification lamp, which are indicated in Fig. 6. The bracket for the headlight and number plate is shown in Fig. 7.

FITTING ROCKER SHAFT BOXES

BY A. G. JOHNSON
Chief Draftsman, Duluth & Iron Range, Two Harbors, Minn.

As a means to facilitate the fitting of rocker shafts in their boxes the arrangement shown in the illustration has been devised and found successful. The rocker box is held in the vise as shown, it being ready for scraping or spotting. If, as it is often necessary, the rocker arm *C* has to be lifted to and from the bench every time it is desired to spot the box two men will be required to handle it. In addition to this it is heavy work and takes time. By providing two ¾-in. rods, as shown at *B*, bent to fit into the bolt holes of the box, the rocker shaft can be lifted out and rolled back out of the workman's way and at the same time be easily handled. With it in this position the box can be spotted and the shaft tried as many times as necessary without much time or physical strength and without the danger of denting or marring the bearing or the box.



Method of Holding Rocker Shafts While Fitting the Boxes

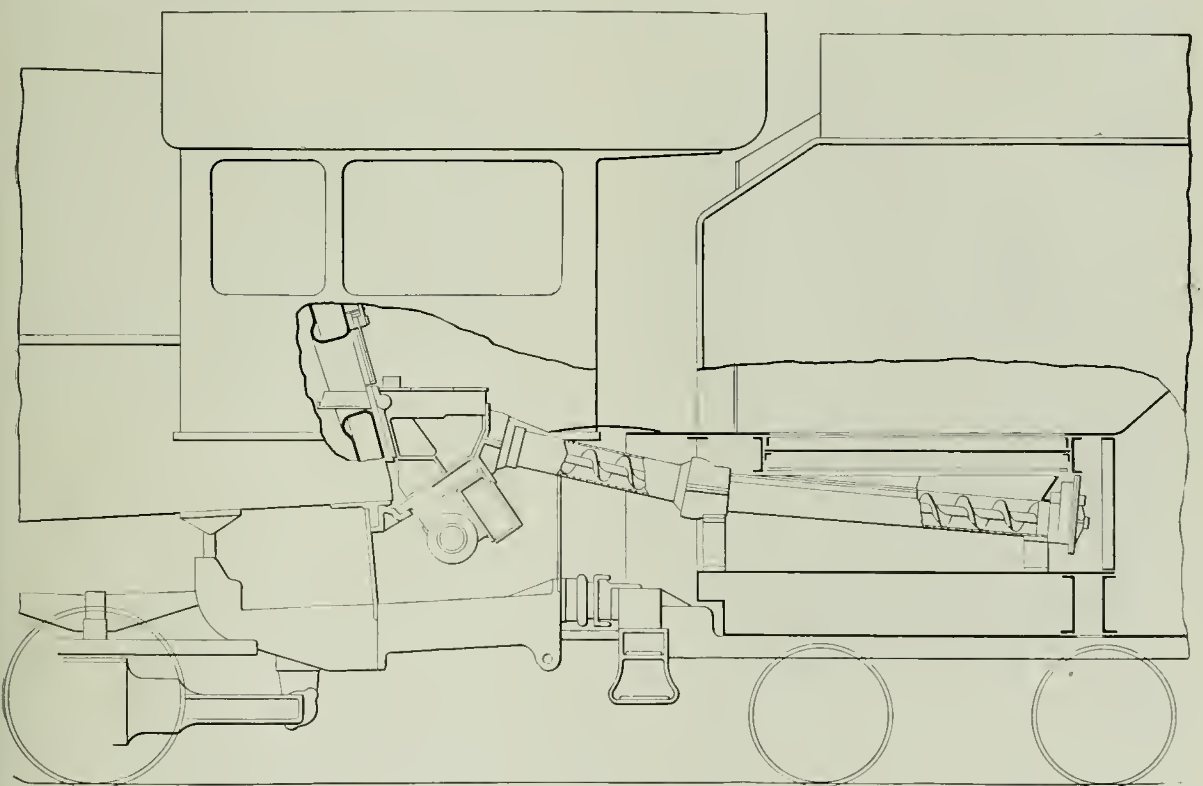
NEW DEVICES

THE ELVIN MECHANICAL STOKER

A mechanical stoker, in which the entire distribution of the coal in the locomotive firebox is effected by mechanically operated shovels, without the use of steam jets, has been developed by the Elvin Mechanical Stoker Company, New York. One of these stokers has been in road service on the Erie for the past three months with results which have demonstrated the feasibility of the method of distribution employed and which indicate an economy in the use of coal equal to, if not exceeding that obtainable by hand firing under favorable conditions. The locomotive equipment consists essentially of three parts: the stoker proper, the agitator and feed control on the tender and the screw conveyor between the engine and tender. The equipment is designed to handle the usual grade of prepared stoker coal.

The stoker proper is assembled in a complete unit which is mounted on the back boiler head and braced to the mud ring by cast brackets. The proportions of the machine and its location on the backhead are shown in one of the drawings. The one design is adapted to backheads of varying slopes by the insertion of filler blocks of suitable taper between the stoker and the boiler head. The stoker consists essentially of two distributing shovels operating through the fire door opening and an elevator for bringing the coal from the conveyor to the level of the shovels.

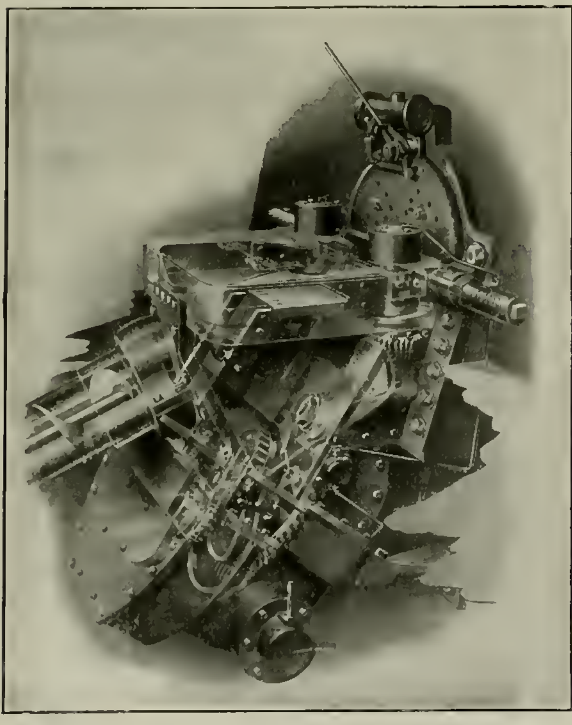
The distributing shovels are mounted on vertical shafts, the lower ends of which carry segmental bevel gears. These gears are driven by bevel segments carried on the upper ends of a pair of centrally pivoted drive arms, the lower ends of which carry steel rollers running in the grooves of a double-faced flat cam. The cam is driven by a worm gear from the main stoker shaft and revolves in a plane approximately parallel to the usual inclination of the backhead of the boiler. Each revolution of the cam completes a cycle of shovel operation; that is, one shovel moves around into



Elevation Showing the Location of the Stoker Equipment on the Locomotive the firebox and returns to remain idle while the other shovel performs the same movement.

Upon the cam is mounted a spur gear which, through a meshing gear of one-half its diameter, drives the elevator crank shaft. The elevator is thus raised and lowered twice during each revolution of the cam, one for each of the two shovels. The elevator, which moves up and down on an inclination parallel to the cam, has an approximately level top surface measuring 7 in. by 12 in. In its lowest position coal as it is delivered by the screw conveyor falls directly on the top of the elevator. As it moves up, a long apron extending downward from its back side forms the front wall of a V-shaped pocket in which the coal accumulates until the elevator again returns to the lower end of its stroke. As the elevator is gear driven directly from the cam, its movement synchronizes perfectly with that of the shovels. The crank is set so that the elevator reaches the top of its stroke just as a shovel is swinging over it. A slight inclination of the top of the elevator compensates for the small amount of downward movement which has taken place before the shovel has moved completely across its top. One of the shovels thus picks up the pile of coal from the top of the elevator at each stroke and carries it forward into the firebox.

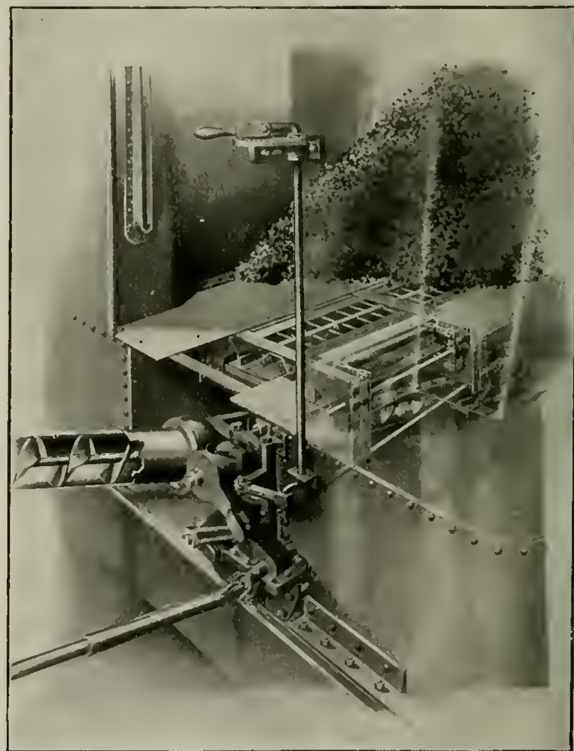
The upper part of the stoker casing forms a box-shaped chamber known as the shovel box, which is covered by



Phantom View of the Elvin Stoker Attached to the Back Boiler Head

hinged lids. The forward end of this box is open to the firebox and the shovels swing therein. The total height of the box is 5½ inches over the cover. The stoker thus uses the lower 5½ inches of the firedoor opening and that part of the door opening above the stoker is closed by a butterfly door, which is used for inspection and hand firing if necessary.

The shovels are L-shaped, with a flat bottom and a back, the maximum height of which is 4½ in. This is reduced to a height of 1¼ in. around the end of the shovel to permit a portion of the coal to be retained in the shovel until the end of the forward throw. As will be seen from one of the drawings the shovels are pivoted at either side of the fire door, and are swung through an arc of about 140 deg. The use of a cam drive has made possible the attainment of the speed variations required in the course of the forward swing of the shovel to accomplish the picking up and distribution of the fuel without shock and with constant uniformity. In action the shovel movement is uniformly accelerating until the charge of fuel has been picked up, or until the shovel has passed over the elevator; then the movement is rapidly accelerated until the shovel tip has entered the firebox when



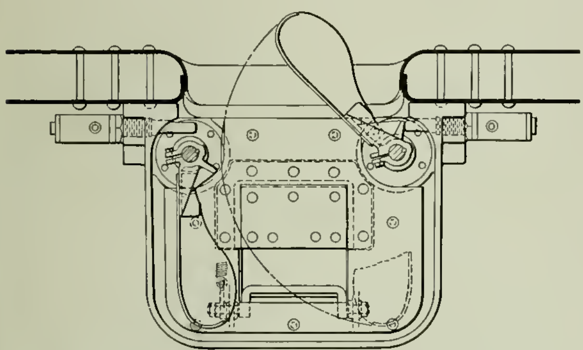
Phantom View of the Tender Equipment of the Elvin Stoker

it is rapidly decelerated. During this deceleration the fuel slides forward on the shovel and off the end where the back is reduced in height and at a tangent to the back of the shovel; but as the back is moving in an arc the effect is to spray the fuel throughout the remaining travel of the shovel, and that portion of the fuel held by the 1¼-in. vane is projected parallel to the backhead when the shovel stops.

The changes in the speed of the forward movement of the shovels have the effect of distributing the fuel uniformly over the entire grate area. The distribution is capable of variation, by changes in speed of the stoker engine; an increase in speed throws a greater amount of the fuel toward the front of the firebox, while a decrease fires heavier to the rear. Irrespective of the speed of the shovels, however, a portion of the fuel is always held by the shovels to fire the back corners of the box. In practice it is found that there is a certain speed which will give the proper distribution under normal conditions and the stoker should be operated at this speed, except when occasionally it may be advisable to fire heavier at the front or rear of the firebox. In practice the speed of firing is about 34 shovels per minute, or a cam speed of 17 r. p. m. The amount of fuel fired is independent of the shovel speed, and the distribution is not affected by the quantity.

All working parts of the stoker, with two exceptions, are run on ball bearings in a dust-proof casing, and are in a constant bath of oil. The oil level is maintained at a point above the main worm shaft and the oil is pumped to the highest bearings to return by gravity. The connecting rod driving the elevator, being outside the stoker casing proper, is provided with graphalloy bearings which require no oil and give long service without attention. The stoker is operated by a No. 3½ Dake reversing engine, which is rated at 7½ h. p. at 100 lb. pressure. The steam line to the stoker is provided with a regulating valve which is set for 25 lb. and is blocked for a maximum of 60 lb. The whole of the stoker mechanism is designed to withstand the maximum power of the engine without failure, and the engine will stall before any part of the mechanism can be unduly stressed.

The conveyor extends from the stoker rearwardly under the coal space of the tank and is in two parts. It is supported rigidly upon the tank, and the portion between the engine and the tank is arranged to swivel to compensate for curvature and to telescope for varying lengths of coupling. The rear end of the conveyor screw is carried in a trough



Top View of the Stoker with the Cover Removed from the Shovel Box, Showing the Elevator at the Top of Its Stroke

and between engine and tank it is carried in a pipe. The conveyor is driven from the rear through gearing enclosed in dust-proof casings. The drive is taken through worm gearing from the main stoker shaft, enclosed in the stoker casing and running in oil. A universal slip joint shaft transmits the power from the engine to the tender.

Under the floor of the tank and above the conveyor is the feeder which consists of an agitator, a deflector and a feeder plate. The agitator is a grating with a double row of 3⅛ in. openings, and is operated from a rock shaft which also moves the feeder plate. The feeder plate is located under the deflector plate so that when operating full stoke the openings in the plate register fully with openings on either side of the deflector plate, first on one side and then on the other.

A simple mechanism on the rock shaft, which operates the agitator and feed plate, provides for varying the throw of the shaft and the size of the plate openings which register with the deflector plate openings, thus controlling the quantity of coal fed to the conveyor, which runs at constant speed. This device is controlled by a handle operating on a quadrant on the front of the tank, where it is readily accessible to the fireman. The range of feed varies from zero to the maximum, which is 12,000 lb. of coal an hour.

The conveyor is designed to carry the maximum coal feed when running one-third full. This makes the movement of the fuel easy as the action of gravity tends to roll the coal along ahead of the screw, and it reduces the danger of clogging to a minimum. The ease with which the coal is moved may be tested by turning the engine over by hand, which can easily be done with the whole device under full load.

The stoker maintains a very thin fire over a greater part of the grate area, which gradually becomes heavier toward the front, rear and sides of the box, where the heaviest fire is needed. The thin character of the fire is clearly indicated by the fact that within a very few minutes after the throttle has been closed and the stoker stopped, the only fire still burning is around the outside of the firebox, while the central portion of the grate is dead. On starting the stoker, however, the thin charges of coal immediately ignite over the entire area of the grate and a uniformly hot fire is maintained as long as the stoker continues to operate. The rapid building up of the fire and the steam pressure following the starting of the stoker has made possible a saving in standby losses, as little need be done, either to maintain the fire or the steam pressure during detention time on the road beyond the minimum necessary to start the train. A characteristic of the distribution of the coal which also tends toward economy is the projection of the lumps forward under the arch while the finest of the coal is retained in the shovels to be deposited in the back corners of the box furthest from the most violent action of the draft. Comparative freedom from large cinders is a noticeable feature of the operation of the locomotive equipped with this stoker.

TEST DATA

The Erie locomotive to which the Elvin stoker was applied is of the Santa Fe type with the following dimensions:

Size of cylinders	31 in. by 32 in.
Diameter of drivers	63 in.
Weight on drivers	337,400 lb.
Total weight of engine loaded	417,200 lb.
Total heating surface	5,660 sq. ft.
Superheating surface	1,389 sq. ft.
Total equivalent heating surface	7,743.5 sq. ft.
Tractive effort	83,000 lb.
Grate area	88 sq. ft.

A series of tests were made with this locomotive, employing a dynamometer car and accurate means for correctly determining the quantity of coal and water used. These tests were made on the Second district of the Meadville division between Meadville, Pa., and Kent, Ohio, during the month of November last, under prevailing temperatures of 32 deg. F. This division has a ruling grade both east and westbound of one per cent and is generally rolling in character with little to distinguish between the physical characteristics of the division east and westbound. A brief summary of the results of these tests is given in the table.

Average Results of Elvin Stoker Tests on the Meadville Division of the Erie Railroad

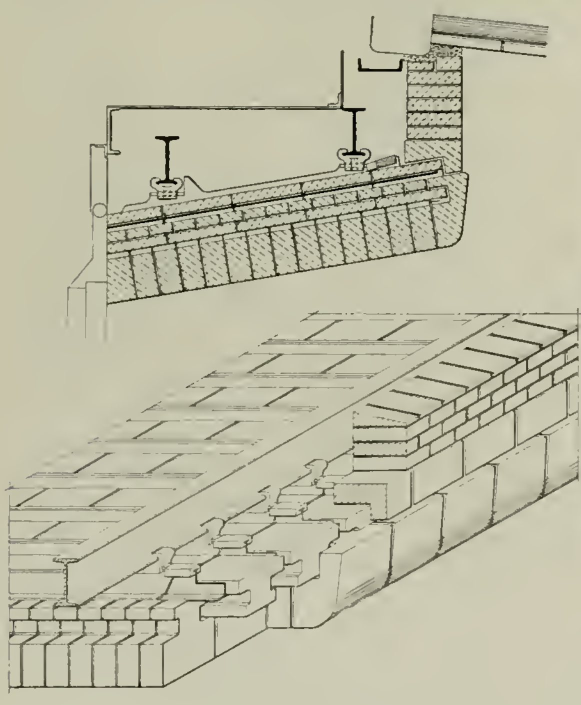
Length of run, miles	89.3
Time on road, hr. min.	9:50
Detentions, hr. min.	3:57
Running time, decimal hr.	5.88
Actual M's (1,000 lb.)	4.243
Adjusted M's	5.133
Total actual M's (inc. eng. and ten.)	4.816
Average drawbar pull, lb.	24,362
Average speed, m.p.h.	15.56
Average temp. superheated steam, deg F.	693
Million ft-lb. of work	11.482
Total coal as fired, running time, lb.	25,679
Coal as fired to do 11,482 million ft.-lb. work, lb.	25,679
Equivalent evap. per lb. dry coal, running time, lb.	8.60
Equivalent evap. per lb. dry coal, combustible, lb.	9.59
B. t. u. per lb. of coal as fired	13.157

It was developed during the tests that practically perfect distribution of the fuel was obtained under all conditions. The fire was maintained at a uniform level without the necessity of using the rake or shaking the grates, notwithstanding the variable operating conditions met on this division. The engine arrived at terminals with approximately six to ten inches of fire on the grates, except a point immediately under the arch at the forward end of the firebox, where the fire was somewhat heavier.

No difficulties were encountered in cleaning the fire at terminals because of the comparative absence of clinker. The results of the tests indicate very favorable evaporation per pound of coal fired. Under ordinary circumstances locomotives of the Santa Fe type on this division require coaling and fire cleaning between terminals. During the tests, however, it was unnecessary on any of the trial trips to clean the fire on the road and the grates were operated only to relieve the accumulation of ashes. On two occasions it would have been easily possible to make a round trip without attention to the fire other than shaking the grates. This condition is in a measure attributed to the absence of moisture which is injected into the firebox with most of the other types of locomotive stokers now in use. The locomotive will handle tonnage trains over this division with the use of less than one tank of coal.

DOUBLE SUSPENSION ARCH FOR STATIONARY BOILERS

It is usually desirable to operate stationary boilers for long periods without shutting them down. When working at high capacity it is not an infrequent occurrence to have the arch give way, and this often happens when it is extremely inconvenient to take the boiler out of service. There has recently been devised by the Liptak Fire Brick Arch Company, St. Paul, Minn., a type of arch for stationary boilers which is intended to overcome such difficulties. This is known as the Liptak Double Suspension Arch. It is made up of two layers of interlocking bricks, suspended from cast



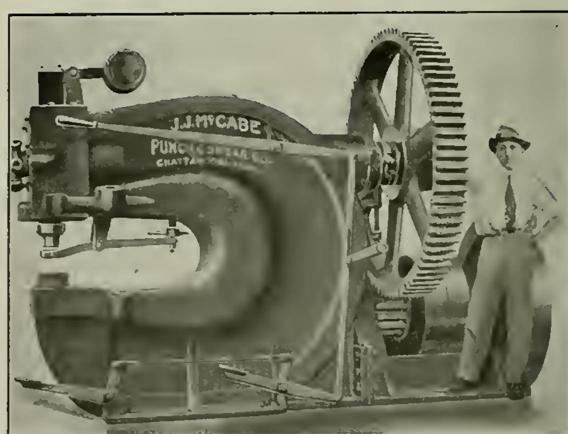
Double Suspension Arch for Stationary Boilers

iron supporting beams which in turn are fastened by clips to transverse I-beams. The perspective drawing accompanying this article shows the construction clearly. It will be noted that the upper arch furnishes almost complete protection for the cast iron supporting beams. Even if the lower arch is completely burned away the boiler can still be operated until the time when it can be shut down without inconvenience.

The lower arch can readily be renewed by the boiler room force as it is simply necessary to slide new lower arch bricks into the grooves of the reserve arch. This eliminates the services of an experienced mason, which are not always available. In case the end blocks are completely burned away, exposing the ends of the cast iron supporting beams to such an extent as to damage them, it is not necessary to renew the entire beam as replaceable tips are provided. The rear bricks in any arch are the first to give out. With this type it requires only a short time after the boiler is cooled down to renew the rear blocks and place the boiler in condition for service. It should be noted that the L-shaped blocks resting on the reserve arch and supporting the brickwork from the arch to the boiler header do not interfere with the lower arch. This permits the renewal of the lower brick without disturbing the rear wall. One of the important advantages of this type of arch lies in its adaptability. It can be built for any width and length to suit the requirements of all types of boilers and stokers. It is claimed that the Liptak arch has a long life and will stand high overload. Arches of this type have been in service for several months and the only repairs required have been the application of new rear blocks.

HEAVY PUNCH AND SHEAR

An improved design of heavy pattern punch and shear machine has been recently developed by the J. J. McCabe Punch & Shear Company, New York City. The illustration shows a machine having a 36-in. throat. The 50-in. machine is of the same general type. Particular attention has been given in the construction of the machine to rigidity to withstand heavy service, the frame having a heavy rib on the back. The head is driven by cam and rollers of carbon steel, which doubles the power during the working stroke and eliminates friction and wear. The clutch is of a new



Heavy Duty Punch and Shear

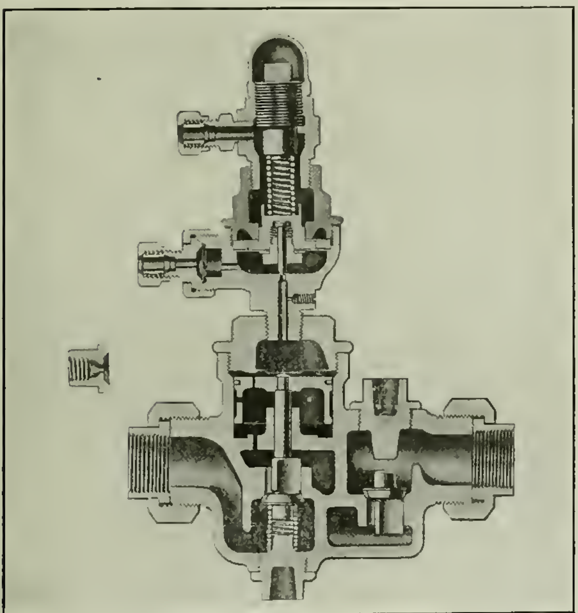
style, being made entirely of steel and equipped with an automatic stop so that the machine may be stopped at any desired point of the stroke. It is operated by either a hand lever or two foot levers arranged conveniently to the operator. The bearings of the machine are of hammered steel forged from the billet, the main bearings having heavy bronze bushings with facilities for taking up the wear. This machine will punch a two-inch hole through one-inch plate and will shear 1½-in. plate, 8-in. by 1⅛ flat bars, 2¼-in. round bars, or 6-in., by 6-in. by ¾-in. angles. The regular equipment provided consists of tight and loose pulleys for belt drive, a punch and die holder, and one punch and die of any size desired up to the full capacity of the machine.

PARASITE RESERVOIR GOVERNOR

The use of compressed air on locomotives for pneumatic devices other than the air brake, such as reversing gear, bell ringers, water scoops, etc., has reached a stage where it is considered necessary by some roads to protect the supply of air for the air brake from becoming depleted from the operation of these so-called "parasites." To accomplish this protection the Westinghouse Air Brake Company has developed a device known as the "Parasite" reservoir governor, which is so designed as to permit charging of the "Parasite" reservoir (or reservoir from which the parasites are supplied) from the main reservoir, only when the main reservoir pressure is above a certain predetermined amount sufficient to safely operate the brakes. The air-operated devices on the locomotive are thereby prevented from "robbing" main reservoir pressure, and, in consequence, the brake system itself.

This governor consists of a diaphragm portion and a body or valve portion which embodies a piston, a spring valve and a non-return check valve. Pipe connections are made, as illustrated, from the main reservoir and the brake valve feed pipe to the diaphragm portion and from the main reservoir to the body portion, and also from the parasite reservoir to the body portion.

When charging the parasite reservoir, air will flow from the main reservoir to below the diaphragm and tbrough the



Governor for Regulating the Pressure of the "Parasite" Reservoir

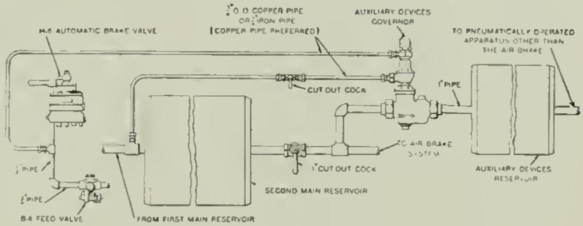
feed valve to the top of the diaphragm, but the diaphragm valve will remain seated until the main reservoir pressure reaches that for which the regulating spring is adjusted, plus the pressure on the brake valve side of the feed valve, when the valve will unseat, allowing air to flow to the top of the piston in the body.

The piston is thereby moved downward, opening the valve below it, at the left, and allowing main reservoir air to flow directly to the parasite reservoir past the non-return check at the right.

When air is being taken from the parasite reservoir for the operation of the parasites the pressure will fall a like amount in both reservoirs until it reaches that for which the governor head is set, when the diaphragm valve will seat and prevent further flow of air from the main reservoir.

Should the pipe between this governor and the parasite reservoir break, air in the main reservoir will not be lost because the diaphragm valve will seat as soon as the pressure in the parasite reservoir drops to that for which the governor head is set. Should a main reservoir pipe break, the non-return check valve 5 (at the right) will prevent the loss of parasite reservoir air.

Thus, should the parasite reservoir pipe break or the pressure become reduced abnormally through operation of the

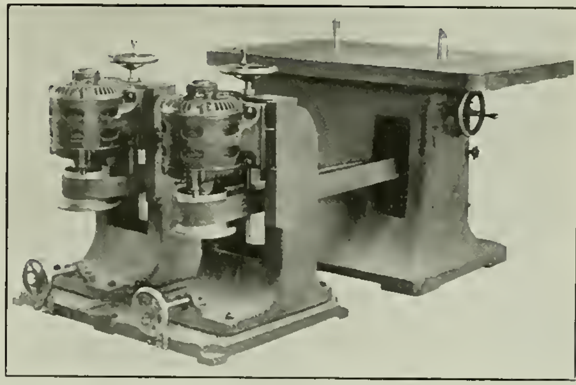


Connections for the "Parasite" Governor

parasites, the parasite reservoir governor would prevent the loss of main reservoir air below a point necessary for the operation of the brakes. Furthermore, should main reservoir pressure be lost through the breakage of a main reservoir pipe or be reduced abnormally from any other cause, the Parasite reservoir governor would prevent the loss of parasite reservoir pressure, thereby making it possible to reverse the engine if provided with a pneumatic reversing gear, or to operate the other parasite apparatus.

NEW MOTOR DRIVE FOR DOUBLE SPINDLE SHAPERS

The Oliver Machinery Company, Grand Rapids, Mich., has developed an interesting and useful compact motor drive for double spindle shapers. As shown by the illustration, standard vertical motors are used, one for each spindle. Each motor is mounted on vertical gibbed ways and is adjusted in height by means of a handwheel and screw to accommodate any height of the spindle which may be required



New Motor Drive for Double Spindle Motors

by the work at hand. Each motor stand can be adjusted longitudinally and the motors are controlled independent of each other, thus permitting the use of but one spindle when two are not necessary. This new arrangement takes up a small amount of floor room, occupying space seven feet long by five feet wide. Standard vertical motors of any type can be used, there being no need for a special built-in motor. The arrangement can be applied to old shapers as well as new and any kind of starting units can be furnished.

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WE GUARANTEE, that of this issue, 7,700 copies were printed; that of these 7,700 copies 6,872 were mailed to regular paid subscribers, 57 were provided for counter and news company sales, 192 were mailed to advertisers, 25 were mailed to employees and correspondents, and 554 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 15,100, an average of 7,550 copies a month.

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The Canadian Railway War Board announces that freight cars of Canadian roads may now be allowed to go into the United States. During the pressure of the past year this use of Canadian cars has been forbidden. Arrangements have now been made with the United States Railroad Administration whereby Canadian cars will be promptly returned to their owners.

S. M. Felton, president of the Chicago Great Western, and until December 31 director general of military railways, was awarded the distinguished service medal by the Secretary of War on January 18, on the recommendations of Gen. Peyton C. March, chief of staff, for "especially meritorious and conspicuous service in supervising the supply of railway material and the organization of railway operation and construction troops."

In the week ending January 4, locomotives in service on lines in the Northwestern region numbered 8,004, making the efficiency 85.2 per cent. The number of freight cars on the Northwestern lines during the week totaled 370,052, compared with an ownership of 334,615. Bad order cars numbered 20,886 (or 5.6 per cent), as compared with 18,916 (6.5 per cent) for the same week in 1918. Freight cars in outside shops totaled 208. The number of employees in service in car repair shops totaled 21,275 (working an average of 47 hours in the week), as compared with 17,537 in the same week of 1918.

Upon the recommendation of General Pershing, a distinguished service medal has been awarded to Brig. Gen. William W. Atterbury, formerly vice-president of the Pennsylvania Railroad, "for exceptionally meritorious and distinguished services." As director general of transportation in the face of almost insurmountable obstacles he organized and brought to a high state of efficiency the transportation service of American Expeditionary Forces. The successful operation of this most important service, upon which the movements and supply of the combat forces were dependent, was largely due to his energy, foresight, and ability.

The National Railways of Mexico, according to a report from Monterey, are being rehabilitated under plans which are making a fair degree of progress. All bridges on the main lines are now repaired and in use, and many of the stations have been rebuilt in a permanent manner. The roadbed is reported in fair condition. The number of locomotives in service is about 500, of which 100 belong to industries along the line and are used in the freight service of their owners. About 250 more locomotives are awaiting repairs, delay having been incurred in getting the repair parts from the United States. To handle even the minimum volume of traffic about 1,000 locomotives ought to be constantly in use, and the question of acquiring some new ones is now under consideration.

The Present Position of German Rolling Stock

In almost every direction, says an article in a recent issue of Engineering (London), Germany finds herself in a most serious plight, and the shortage and disrepair of rolling-stock is not the least important factor. Before the war Germany had about 700,000 freight cars and 30,000 locomotives. The number of the latter, as of the former, has certainly been increased during the war, through seizures in Belgium and France; but on the other hand some 4,000 locomotives may be looked upon as at least temporarily unavailable, being at present stranded in often remote occupied territory. As far as a portion of these 4,000 engines is concerned, it is doubtful whether they will ever return. Some 8,000 locomotives are badly in need of repair. Thus the 5,000 locomotives which have to be handed over, according to the terms of the armistice, represent about one-fourth of those available, and efficient. Apart from this there is some doubt as to whether or not the locomotives of the Alsace-Lorraine State railways are included in the above 5,000 engines. The proportion of increase and decrease as regards freight cars may be taken to be about the same as with the locomotives. The question then remains as to what extent German works will be able to make good the compulsory surrender of these 5,000 engines, for of the purchase of locomotives from abroad there can be no question at present. The capacity of the German locomotive factories is at the present moment, with some reserve, put at 2,500 large locomotives per annum. This estimate, of course, is subject to sufficient raw materials and other necessities being available as well as a sufficiency of skilled and trained and willing labor. If it really were possible satisfactorily to overcome these and other difficulties, and also in other ways to return to an ordered state of affairs, and entirely to ensure and rely upon the large left-Rhine production of raw materials for the whole reconstruction period, it would take the

German railways two or three years to recover from the blow which their defeat has entailed. During this considerable period German industry would be entirely debarred from export of full-size locomotives and confined to narrow-gage engines, of which it can supply some 1,500 in the year. The position is made additionally difficult, because Germany has to deliver up efficient locomotives, so that those which remain include all those more or less unfit for use. The repair of these, in addition to that of the 8,000 locomotives referred to above, will be very difficult to effect, but as the state railways are compelled to exercise the greatest economy these repairs will probably first be proceeded with.

It is being suggested in Germany that firms which have not formerly gone in for the building of locomotives, of which the majority have been engaged in war work, might with advantage take up the manufacture of locomotives, as has already been done by the Allgemeine Elektricitäts Gesellschaft.

As regards the building of freight cars the capacity of the German works during the last few months of the war has been put at 50,000 per annum. In case all necessary raw materials which are nearly all produced within the country, be made available and the industry not be handicapped by other adverse circumstances, the above-mentioned capacity might perhaps be increased by 50 per cent. Even then it will take Germany three years to replenish her stock of freight cars.

Changes in M. C. B. Interchange and Loading Rules

The Master Car Builders' Association has recently issued Circular No. 25 announcing certain changes in the 1918 Code of Interchange Rules. A second paragraph has been added to rule 8, which specifies that when repairs are made to cars of private ownership equipped with a receptacle for cards, a copy of the billing repair card shall be inserted in the receptacle. A new rule, No. 23, has been formulated, which provides for the periodical repacking of journal boxes. Rule 120, with some modifications, has been reinstated, effective January 1, 1919, to provide for the disposition of cars belonging to private car lines and railroads not under federal control which require extensive repairs for which the owners are responsible. The circular also contains two interpretations of Article 11 of the rules of interchange for 1918.

The loading rules of the Master Car Builders' Association as revised for 1918 have been approved by the Railroad Administration and are now ready for distribution. Numerous changes have been made in the present volume. The size of the pages has been increased to 5¼ in. by 7½ in. in order to permit the use of larger and clearer cuts. The general rules for loading material have been grouped in the first section and following these are the complete instructions regarding the handling of various commodities. All the rules governing the loading of each commodity are grouped together so that it is not necessary to refer to various portions of the book. In case railroads desire to provide copies of the rules for shippers, any of the sections will be printed in pamphlet form by the association. The Car Service Section has issued a circular instructing the railroads to refer any questions regarding loading that may arise to the secretary of the M. C. B. Association.

MEETINGS AND CONVENTIONS

Master Boilermakers' Association.—The 1919 convention of the Master Boilermakers' Association will be held in Chicago May 26, 27, 28 and 29 at the Hotel Sherman. This will be the first convention since 1916, the association having suspended activities on account of the war. The subjects to be discussed at the convention, together with the committees, follow:

1. Proper method of threading radial stays and tapping the hole in the boiler for them.
   Is it necessary to give radial stays the same lead as the tap with which the holes were tapped?
   Committee: H. J. Raps, chairman; Andrew Hedberg, J. J. Keogh, J. B. Smith, T. J. Reddy.
2. Which is the better time for drilling tell-tale holes, before or after application of the bolts?
   Which is the better method for drilling in either case?
   What is the best style of drill for opening up tell-tale holes in old staybolts?
   Does it pay to use a high speed drill for this purpose?
   What is the best lubricant for the drill?
   Committee: L. R. Porter, chairman; A. N. Lucas, S. M. Carroll, Bernard Wulle, C. E. Erwin.
3. Effect of proper upkeep of ash pan and front end draft appliances on fuel economy.
   Method used in determining proper design for various classes of locomotives.
   Committee: George Austin, chairman; E. J. Nicholson, Fred Bayer, H. F. Weldin, George Hewitt.
4. What is the best method for scaling superheater flues in the boiler?
   What is the best method of rattling flues?
   What is the best method of handling flues in and out of the rattler?
   How many revolutions per minute should the rattler make for 2-in. and for 5⅜-in. flues?
   Describe method for safe ending superheater flues.
   Committee: Frank Gray, chairman; W. J. Murphy, Andrew S. Green, John Harthill, J. J. Mansfield.
5. What is the best style grate for bituminous coal?
   Where should the dump grate be located, (a) in road engines, (b) in switch engines?
   What should be the percentage of opening in grates?
   What should be the percentage of draft opening in ash pans compared with area of grates?
   Committee: W. H. Laughridge, chairman; L. M. Stewart, T. P. Madden, C. P. Patrick, C. A. Nicholson.
6. What should be the minimum distance between the grates and the lower part of arch tubes for different classes of locomotives?
   What is the proper distance from the door sheet to the brick arch and from the crown sheet to the brick arch for the various classes of locomotives?
   Committee: C. L. Hempel, chairman; W. F. Fantom, A. E. Brown, E. W. Young, G. B. Usherwood.
7. What is the best method of bracing locomotive tenders? Describe method used.
   Committee: Thomas Lewis, chairman; E. J. Sweeney, J. J. Orr, J. P. Malley, J. T. Johnson.
8. Oxy-acetylene and electric welding.
   Committee: H. J. Wandberg, chairman; B. F. Sarver, L. M. Stewart, T. F. Powers, J. J. Davey.
9. What is the advantage of cutting off stay ends with oxy-acetylene over old method of nippers and chisels?
   Committee: W. S. Larason, chairman; John McGarrigal, J. B. Tynan, E. H. Hohenstein, A. E. Shaule.
10. General discussion.

Central Railway Club.—At the January 10 meeting of the Central Railway Club the following officers were elected for the ensuing year: President, Frank C. Pickard, master

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Feb. 3	Storage of Coal and Spontaneous Combustion	D. H. Pudney.......	James Powell ...	P. O. Box 7. St. Lambert, Que.
Central	Mar. 14	Unified Inspection and Maintenance of Car Equipment	J. J. Tatum.........	Harry D. Vought.	95 Liberty St., New York.
Cincinnati	Feb. 11	Efficiency	Charles Dick	H. Boutet	101 Carew Building, Cincinnati, Ohio.
New England ...	Feb. 11	United States Railway Batteries in France. Red Cross Work in France............	....	W. E. Cade, Jr..	683 Atlantic Ave., Boston, Mass.
New York	Feb. 21	Standardized Statistics	Wm. J. Cunningham.	Harry D. Vought.	95 Liberty St., New York.
Pittsburgh	Feb. 28	....	....	J. D. Conway....	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	Feb. 14	Informal talks by Lieutenant Colonel Frank G. Jonah and J. A. Somerville.........	....	B. W. Frauenthal.	Union Station, St. Louis, Mo.
Western	Feb. 17	....	....	A. F. Stuebing...	750 Transportation Bldg., Chicago.

mechanic, D., L. & W.; vice-presidents, H. T. Malcolmson, superintendent, T. H. & B.; L. C. Fitzgerald, shop superintendent, Erie, and M. W. Hassett, master mechanic, New York Central. H. E. Myers, master mechanic, Lehigh Valley, was elected to the executive committee. The retiring president, W. H. Sitterly, general car inspector, Pennsylvania, was added to the list of past presidents, who are also members of the executive committee.

Master Mechanics' Association.—At a meeting of the executive committee of the American Railway Master Mechanics' Association, held in Chicago on January 3, W. J. Tollerton, general mechanical superintendent of the Rock Island Lines, was appointed president of the association to fill the vacancy caused by the resignation of F. H. Clark. C. F. Giles, superintendent of machinery of the Louisville & Nashville, was appointed first vice-president, and C. H. Hogan, assistant superintendent motive power, New York Central, was appointed second vice-president. The position of third vice-president was left vacant and will be filled by election at the time of the next annual meeting of the association.

The June Mechanical Convention.—J. D. Conway, secretary of the Railway Supply Manufacturers' Association on January 23, sent out circular No. 1 extending an invitation to manufacturers of and dealers in railway supplies to exhibit at Atlantic City in June, and giving full details as to the exhibit arrangements.

In his circular Mr. Conway says:

"This is the first exhibition that has been held for three years. The railroad associations have expressed their earnest desire that our association should make a full exhibit, and the United States Railroad Administration gives its unqualified approval of it. Invitations are being extended in the name of the three associations to all foreign trade bodies in this country, and, through the embassies at Washington, to all foreign governments (except the Central Powers), inviting them to send delegates or representatives to attend the conventions and examine the exhibits. The opportunity presented by an exhibition at this time for both the domestic and foreign demand is exceptional."

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 6-8, 1919, Chicago.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

American Railway Master Mechanics' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, New York, N. Y.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention May 26-29, Hotel Sherman, Chicago.

Master Car Builders' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 18-21, Atlantic City, N. J.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C. Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

Personal Mention

GENERAL

N. Bell, formerly master mechanic of the Minnesota and Iowa divisions of the Illinois Central with headquarters at Waterloo, Iowa, who has just returned from military service, has been appointed to the same position, succeeding O. A. Garber.

C. H. Dyson has been appointed fuel agent of the Baltimore & Ohio—Western Lines, the Dayton & Union Railroad, and the Dayton Union Railway, with headquarters at Cincinnati, Ohio.

A. L. Greburn, assistant superintendent of rolling stock of the Canadian Northern, with office at Toronto, Ont., has been appointed general fuel agent of the Canadian National Railways, with office at Toronto.

W. F. Kaderly, general superintendent of the Georgia Southern & Florida, the Hawkinsville & Florida Southern and the St. Johns River Terminal, has been appointed superintendent of motive power of the Southern Railroad, Lines East, with headquarters at Charlotte, N. C., succeeding E. C. Sasser, resigned.

William Gemlo, master mechanic of the Minneapolis & St. Louis at Marshalltown, Iowa, has been promoted to superintendent of motive power and rolling stock, with headquarters at Minneapolis, Minn., to succeed G. M. Seidel. Mr. Gemlo was born at Glasgow, Canada, on September 28, 1868. He began railway work with the Minneapolis & St. Louis as a locomotive fireman in September, 1888, and served in that capacity until October, 1896, when he was promoted to locomotive engineer. In June, 1907, he was appointed roundhouse foreman, and two years later traveling engineer. In October, 1913, he was promoted to master mechanic at Marshalltown, Iowa, which position he held until his recent appointment as superintendent of motive power and rolling stock.

W. Gemlo

E. E. Ramey has been appointed superintendent of fuel and locomotive performance of the Baltimore & Ohio, Eastern Lines; the Coal & Coke; the Wheeling Terminal Railroad; the Western Maryland; the Cumberland Valley, and the Cumberland & Pennsylvania Railroad. The position of supervisor of fuel consumption has been abolished. A photograph, and a sketch of Mr. Ramey's career were published in the *Railway Mechanical Engineer* for May, 1918, on page 294.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

O. A. Garber, master mechanic of the Illinois Central at Waterloo, Iowa, has been transferred to Memphis, Tenn., succeeding W. H. Watkins, granted a leave of absence.

W. B. Kilgore, road foreman of engines of the Baltimore & Ohio, Western Lines; the Dayton & Union Railroad, and the Dayton Union Railroad, with office at Dayton, Ohio, will also assume the duties of trainmaster of the Wellston sub-division, succeeding W. E. Duffey, who has been transferred.

P. T. O'Neill has been appointed division master mechanic of the Chicago, Milwaukee & St. Paul with headquarters at Spokane, Wash., succeeding Fred Lowert, who has been transferred to the St. Paul shops at Tacoma, Wash. Mr. O'Neill was formerly superintendent of motive power of the Idaho & Washington Northern at Spirit Lake, Idaho, and after that line was purchased by the St. Paul he was appointed general foreman at the Spirit Lake shops and later transferred as general foreman to the Tacoma, Wash., shops.

CAR DEPARTMENT

George W. Ditmore, assistant master car builder of the Delaware & Hudson, has been appointed master car builder of that road, the Greenwich & Johnsonville, the Wilkesbarre Connecting Railroad, and the Schoharie Valley Railroad, with headquarters at Colonie, N. Y. The position of assistant master car builder has been abolished. Mr. Ditmore was born on February 17, 1878, at Jermyn, Pa., and was educated in the high school of his native town. He began railway work on June 1, 1897, as a journal packer at Carbondale, Pa., on the Delaware & Hudson, and later served as car repairer. One year later he was promoted to car inspector and served in various other capacities in the car department. In March, 1902, he was appointed an interchange car inspector at Green Ridge yard, Scranton, Pa., and then served as foreman of car inspectors and repairers at the same place and at Buttonwood, Wilkes-Barre, Pa. On December 1, 1913, he was transferred to Carbondale as shop foreman and about four years later he was promoted to division car foreman of the Pennsylvania division. Since November, 1918, he served as assistant master car builder until his recent appointment.

G. W. Ditmore

PURCHASING AND STOREKEEPING

G. W. Alexander, storekeeper of the Central of Georgia, has been appointed general storekeeper with headquarters at Macon, Ga. He was born on February 21, 1886, at Senoia, Ga., and was educated in the high schools. He began railway work in 1905, as a receiving clerk in the freight agent's office of the Central of Georgia, at Atlanta. In 1907 he was appointed ticket agent at Bremen, and then to 1909 was mechanical clerk to the general foreman at Cedartown. From 1909 to 1912 he held different clerical positions in the division storekeeper's office at Macon, and later was appointed division storekeeper at Cedartown. He subsequently served as division storekeeper at Savannah, and from 1914 to April, 1918, as division storekeeper at Macon, in charge of the Macon, Southwest and Chattanooga divisions on the same road. In April, 1918, he became assistant to the Southern Regional Purchasing Committee of the United States Railroad Administration, with headquarters at Atlanta, Ga., and now returns to the Central of Georgia as general storekeeper.

J. H. Nichols has been appointed general storekeeper of the New York, Chicago & St. Louis with headquarters at Cleveland, Ohio.

E. A. Workman, storekeeper of the Baltimore & Ohio Eastern Lines, with office at Keyser, W. Va., has been appointed storekeeper of the Maryland district, with headquarters at Camden station, Baltimore, Md., succeeding O. V. McQuilkin, deceased.

C. L. Nash has been appointed division storekeeper of the Mobile & Ohio with headquarters at Tuscaloosa, Ala., succeeding T. S. Edgell who has been transferred to other duties.

W. J. Diehl, general storekeeper of the Mobile & Ohio, with headquarters at Mobile, Ala., now also has jurisdiction over the Gulf, Mobile & Northern.

Charles W. Yeamans, assistant engineer of the Chicago & Western Indiana, has been appointed purchasing agent of that road and the Belt Railroad of Chicago, with headquarters at Chicago, succeeding R. Benson, transferred. Mr. Yeamans was born at Akron, Colo., on August 12, 1886. He began railway work on May 1, 1905, as a clerk in the engineering department of the Chicago, Burlington & Quincy, with headquarters at Chicago. Two years later he was promoted to chief clerk to the engineer of track elevation. On May 1, 1910, he resigned to go with the Chicago & Western Indiana in charge of the field construction office, with headquarters at Chicago. During the construction of Clearing yard between 1913 and 1915 he was material agent, having full charge of the ordering of materials, their inspection and distribution. Later he became chief clerk in the engineering department, and on May 1, 1918, was appointed assistant engineer in the construction department, which position he held until December 1, when he received his appointment as purchasing agent.

C. W. Yeamans

FEDERAL ADMINISTRATION APPOINTMENTS

A. F. Duffy, assistant manager of the Safety Section, Division of Operation, of the Railroad Administration, has been appointed manager of the section, succeeding H. W. Belnap, deceased.

F. F. Gaines has been elected chairman of the Board of Wages and Working Conditions of the Railroad Administration, succeeding G. H. Sines, and A. O. Wharton has been elected vice-chairman succeeding Mr. Gaines, in accordance with the plan of rotation in office every six months, decided upon at the time of the organization of the board.

J. C. Turner has been appointed representative of the Division of Labor. Mr. Turner will be assigned to conduct investigations and to represent the Division of Labor of the Railroad Administration in other specific matters to which he may be assigned, affecting employees of the railroads under federal control.

Supply Trade Notes

The French government has conferred upon Samuel M. Vauclain, first vice-president of the Baldwin Locomotive Works, the title of Chevalier of the Legion of Honor.

Ernest Baxter has been appointed general sales manager of the Kansas City Bolt & Nut Company, with headquarters at Kansas City, Mo., succeeding L. L. Middleton, promoted.

Edward F. Carry has resigned as chairman of the Port Facilities Commission at Washington to return to his office at Chicago as president of the Haskell & Barker Car Company.

Harry F. Worden, sales manager of the Bryant Zinc Company, with headquarters at Chicago, died in that city on January 14, after a short illness brought on by an attack of acute indigestion.

Alden R. Ludlow, formerly vice-president of the Liquid Carbonic Company of Chicago, has since January 1, 1919, been acting as second vice-president and sales manager of the Air Reduction Company, Inc., New York.

Kenneth C. Gardner has been appointed assistant manager of sales for the Central district of the Pressed Steel Car Company, with headquarters at Pittsburgh, Pa., succeeding Henry P. Hoffstot, who has resigned to become president of the Koppel Industrial Car & Equipment Company.

Joseph B. Weaver, vice-president and general manager of the Harlan & Hollingsworth Corporation, Wilmington, Del., has been appointed vice-president in charge of the manufacturing department of the Pullman Company with headquarters at Chicago.

A. A. Heller, treasurer and general manager of the International Oxygen Company, New York, has given up his active managerial duties, and Eugene Schoen has been appointed general manager for the company. Mr. Heller, as treasurer, continues in charge of the financial departments of the business.

Edward D. Hillman, secretary and engineer of the National Railway Appliance Company, New York, for the past two years, resigned from that company on January 1, and has accepted a position with the new Consolidated Steel Corporation, 165 Broadway, New York.

Captain George A. Post, Jr., of the Ordnance Department, U. S. A., has received an honorable discharge from the military service and has returned to the service of the Standard Coupler Company, as assistant to the president, with headquarters at 30 Church street, New York.

John C. Kuhns has left the service of the Oxweld Railroad Service Company to become identified with the Burden Iron Company, of Troy, N. Y., as manager of railroad sales. His headquarters will be at the Railway Exchange building, Chicago. Mr. Kuhns was formerly purchasing agent of the Illinois Central.

Automatic straight air brake equipment, developed by the Automatic Straight Air Brake Company, New York, is now being manufactured by the American Car & Foundry Company, for both passenger and freight cars. It is reported that within 60 days the installation of these brakes will begin on freight and passenger cars in regular service.

The Vanadium-Alloys Steel Company of Pittsburgh and Latrobe, Pa., maker of high-speed and alloy tool steels, has leased commodious offices and warerooms at 566-568 West Randolph street, Chicago, where will be carried a large stock of "Red Cut Superior" high-speed steel in all the standard sizes and shapes of bar stock, also treated bits for tool holders.

L. L. Body has been appointed manager of railway, street railway and marine sales of the Glidden Company, Cleveland, Ohio. Mr. Body has been identified with paint and varnish interests for many years. He began his career with the Sherwin-Williams Company in 1902, where he rose to the managership of railway and marine sales in 1912. In 1915 he severed his connection with Sherwin-Williams to become sales manager of the Master Builders' Company, Cleveland.

William T. Lane has been appointed district sales manager of the Franklin Railway Supply Company, Inc., with offices at San Francisco, Cal. Mr. Lane has spent his entire business career in the railway supply field. For the past seven years he has constantly been in touch with locomotive development. On leaving college he went as an apprentice with the Franklin Portable Crane & Hoist Company. His next position was as draftsman for the Franklin Railway Supply Company, Inc., and then chief draftsman. In 1915, he was made mechanical engineer of this company, which position he held at the time of his appointment as district sales manager, as noted above.

Wm. T. Lane

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is planning to erect several new buildings at Essington (South Philadelphia), Pa., to take care of turbine an delectric generator construction work that this now being handled at East Pittsburgh. It is planned to build at Essington all the large and important apparatus manufactured by the Westinghouse Company, and it is probable that in the future a building will be erected for the construction of electric locomotives, in which work the Westinghouse Company co-operates with the Baldwin Locomotive Works.

Lieutenant T. W. Jenkins, U. S. N. R. F., has been appointed manager of railway sales of the American Rolling Mill Company, Middletown, Ohio. Previous to the entry of the United States into the European war, Mr. Jenkins was in charge of sales of castings and forgings for this company. When the war broke out he was given indefinite leave to re-enter the navy, from which he had resigned in 1913. Lieutenant Jenkins served as an engineering officer on the navy transports throughout the war. Upon cessation of hostilities he was relieved from active duty to return to the commercial field.

W. C. Lincoln has been appointed engineer for the National Railway Appliance Company, New York. Mr. Lincoln was originally employed by the American Locomotive Company at Schenectady, leaving that company's service to enter Union University. After graduation and the completion of the General Electric Company's test course, he was assigned to special railway work by that company. Subsequently he took up and completed the engineering extension course, after which he was connected for some time with the consulting engineering department. Mr. Lincoln later entered the railway engineering department and in 1913 was transferred to the General Electric Company's Philadelphia district as commercial engineer in the railway department, after which he entered the service of the Railway Improvement Company as electrical engineer.

W. C. L. Lamot, of Antwerp, advises that he is about to return to that city and would like to get in touch with any American firms who desire to establish an agency in Belgium. Mr. Lamot was established in Antwerp from 1907 until the outbreak of the war as an importer, exporter and shipping agent on his own account and had extensive business connections in both the industrial and commercial world. Since 1914 he has been acting as general merchant and commission agent in London, supplying many Belgian and British airplane, munition and engineering works. To facilitate matters he has given the *Railway Mechanical Engineer* a list of his connections as well as references. His present address is 22 Northumberland avenue, London, W. C. 2.

The Grip Nut Company, Chicago, has been reorganized with the following officers: Francis H. Hardy, chairman of the board of directors; William E. Sharp, president; Chester D. Tripp, vice-president; Herman A. Brassert, vice-president; Truman F. Miller, secretary and treasurer. The directors of the company include Messrs. Hardy, Sharp, Tripp, Brassert and Thomas G. Deering. William E. Sharp, who has been elected president of the reorganized corporation, began his railway career as an apprentice in the car department of the Erie in April, 1889. In October, 1892, he was promoted to general foreman of the car and locomotive department of the same road, with headquarters at Chicago. He left the Erie in 1898 to become assistant superintendent of the Armour Car Lines. In April, 1901, he was promoted to superintendent of those lines. He resigned that position in 1911 to enter the railroad supply business as vice-president of the Grip Nut Company. He was elected president in September, 1916, and became president of the reorganized corporation in November, 1918.

W. E. Sharp

The Electro-Dynamic Company, of Bayonne, N. J., which formerly manufactured the electric car lighting equipment for the Consolidated Railway Electric Lighting & Equipment Company, New York, has bought the entire stock in trade, assets, good will, etc., of the latter company, and will continue to manufacture and sell the "Axle Light" equipment formerly sold by the Consolidated, together with all repair parts for the Consolidated equipment now in service on the railroads. The Electro-Dynamic Company is controlled by the Submarine Boat Corporation and is known in the railway field as the manufacturer of the Edco interpole motors for railway shop use, machine tools and submarines. A separate department of the Electro-Dynamic Company has been created, known as the axle light department, to handle this work. There will be no interruption of the former Consolidated business.

Charles H. Wilson, who has been in active military service in France as a lieutenant of engineers, has been honorably discharged from the army and has resumed his duties as representative of Fairbanks, Morse & Co., Chicago. He was one of the survivors of the U. S. SS. "Lincoln," which was sunk by a German submarine 400 miles off Brest, France, while on a return trip to the United States. During his service with the American Expeditionary Forces Lieutenant Wilson, who was a reserve officer prior to the entry of this country in the world war, was attached to the British tank corps as mechanical officer and was later with the U. S. tank corps. On his return he was assigned for duty in the organization of tank corps units here, afterwards being on duty with engineer replacement troops. Prior to his entry into military service Mr. Wilson was located in Houston, Texas, as southwestern representative for Fairbanks, Morse & Co., with which company he has been associated for 14 years. He will now make his headquarters at St. Louis.

The Consolidated Steel Corporation, formed recently to handle the export trade of several independent steel producers, has opened offices in the City Investing building at 165 Broadway, New York. E. A. S. Clarke, former head of the Lackawanna Steel Company, is president of the export concern. The other officers are H. H. Barbour, vice-president, formerly of the Lackawanna Steel Company; W. Hesselman, secretary and controller, and A. Van Winkle, treasurer. Mr. Hesselman was controller of the Lackawanna company, and Mr. Van Winkle was secretary to Mr. Clarke when he was at the head of that concern. The traffic manager is William Heyman, formerly foreign freight agent for the Delaware, Lackawanna & Western Railroad. The independent steel companies represented in the organization are the Bethlehem Steel Corporation, the Brier Hill Steel Company, the Lackawanna Steel Company, the Lukens Steel Company, the Midvale Steel & Ordnance Company, the Republic Iron & Steel Company, the Sharon Steel Hoop Company, the Trumbull Steel Company, the Whitaker-Glessner Company and the Youngstown Sheet & Tube Company. The board of directors of the new export company is made up from the executives of these companies.

Nathaniel M. Rice has been elected a vice-president of the Pierce Oil Corporation, in charge of lubrication, with headquarters at 420 Olive street, St. Louis, Mo. The managers of the railroad lubricating, stationary engine lubricating and automobile lubricating departments will report to and receive instructions from Mr. Rice. Mr. Rice was formerly connected with the St. Louis-San Francisco, having occupied the position of purchasing agent, and later that of third vice-president. He was born December 28, 1863, at Rome City, Ind., received his early education in the public schools at that place, and in May, 1887, entered railway service as a brakeman on the Gulf, Colorado & Santa Fe. He served in various capacities in the transportation and store departments, and on April 1, 1901, he was made assistant general storekeeper of the Atchison, Topeka & Santa Fe Coast Lines, which connection he held until April 1, 1903, when he became general storekeeper in full charge of material, fuel and stationery, serving the entire system. In November, 1913, he was appointed chief purchasing agent of the St. Louis-San Francisco, with headquarters at St. Louis, Mo., and in September, 1916, was elected third vice-president of that road.

N. M. Rice

CATALOGUES

Boiler Tube Cleaners.—A general catalogue, X-4, has been issued by the Lagonda Manufacturing Company, Springfield, Ohio, describing in detail the boiler tube cleaners and accessories and other boiler room appliances manufactured by this company, and stating the work for which each type of cleaner is best adapted. All are illustrated and a number of sectional views are shown with the parts named.

Tool Holders.—Tool holders manufactured by the Gisholt Machine Company, Madison, Wis., for use in turret and engine lathes equipped with turret tool posts, are illustrated and described in a six-page folder issued by that company. Complete dimensions, sizes and prices are given. These holders were designed to make possible the use of worn down tools to the last inch or so, a fact which is of importance with the prevailing price of tool steel.

Graphite Products.—The United States Graphite Company, Saginaw, Mich., has published general catalogue No. 20, which gives detailed information about the line of lubricating graphite, greases, paints, etc., manufactured by this company. It also includes the report of tests made by the chief engineer of the Interborough Rapid Transit Company of New York, to determine the efficiency of graphite under actual operating conditions, and a number of microphotographs and curves.

Electric Industrial Trucks.—Three types of electric industrial trucks designed for different services, including a carrying truck, an elevating platform truck and a tractor, manufactured by the Buda Company, Chicago, are described in its bulletins, 327, 328 and 329, respectively. These give a general description of the construction and specifications for each type, as well as illustrations and drawings. Bulletin 326 contains a brief description of the mechanical features common to all three types.

Mallet Articulated Locomotives.—Record No. 91, published by the Baldwin Locomotive Works, Philadelphia, Pa., is devoted to a non-technical description of Mallet articulated locomotives, illustrated with two sectional drawings. Instructions are given for the proper handling of these locomotives, as well as formulas for calculating their tractive effort. The booklet also contains a number of illustrations of various locomotives of this type, both for foreign and domestic roads, with their dimensions and general data.

Rust Preventives.—The Dearborn Chemical Company, Chicago, has issued a booklet entitled "The Prevention of Rusting or Corrosion of Iron and Steel," for the purpose of presenting evidence of the success that has followed the use of No-Ox-Id, a rust preventive developed by the Dearborn Chemical Company, as well as to describe other Dearborn products, including Dearboline, a preparation for cleaning machined parts of emery or grease, Klean-Kleen, for use in cleaning metal during various stages of manufacture, and cutting, quenching and drawing oils, etc.

Iron and Steel Products.—A new edition of the Interstate Blue Book has been published by the Interstate Iron & Steel Company, Chicago. This book contains 204 pages and gives complete information regarding all Interstate products. Bars, bands, angles, channels, tees, flats and special shapes are shown with sizes listed for both wrought iron and high or low carbon steel, and the many other products of the company, including wire and wire products, staples and rivets are fully illustrated and described. The book contains the National Iron and Standard Steel classifications of price extras, as well as a number of weights and gages and other valuable information conveniently arranged for ready reference. The alloy and special analysis steels from the South Chicago plant are also described.

Turret Lathes.—The Gisholt Machine Company, Madison, Wis., has issued a 102-page, 7¾-in. by 9½-in. catalogue, TLC-1, describing Gisholt turret lathes. It was the purpose in preparing this catalogue to show particularly what kinds of work these lathes will do. It contains over 100 illustrations, including a number of close-up views of the lathes actually at work, followed by 22 pages of line drawings showing parts which are successfully finished on Gisholt lathes; the time for finishing these parts is given under each drawing. A general description of the machine is also given, together with specifications and dimensions, and the last part of the book is devoted to standard tools for the lathes, boring bars, reamers, tool holders and chucks. The turret on carriage and gap lathes, as well as the motor driven lathes, are illustrated and described.

Westinghouse Instruments and Relays.—The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has issued a revised edition of catalogue 3-B, listing and describing Westinghouse switchboard, portable and precision instruments, ammeter shunts, transformers and relays. The catalogue contains 104 pages, 8½ in. by 12 in. and gives complete information about each instrument, describing the principle of operation and construction, as well as the work to which the instruments are especially adapted. Wherever possible each particular type of apparatus is listed on only one page and where more than one page is required, the several pages are confined to a description and listing of only one particular type, so that it is not difficult to find desired information. Several new types of apparatus are listed for the first time in this edition.

Tool Steels.—The Carnegie Steel Company, Pittsburgh, Pa., is now offering to the trade a new line of electric carbon tool steels made in five grades, containing different proportions of carbon, which are intended for utilization in the manufacture of tools where heretofore alloy steels have been used. A catalogue has been issued describing these steels and presenting practical information for the steel user, without going into an extended discussion of the theories of heat treatment. It contains a chart in colors of heat and temper colors which is a direct reproduction by color photography from test pieces heat treated to the temperatures shown. It affords a direct comparison by the blacksmith in the shop whereby it is possible to eliminate the effect of different lighting conditions. Pages devoted to reproduction of labels of the five grades also specify the various uses for each different grade of steel, and permit the selection of the proper grade for any particular use.

"Under Frame" Car Lighting Equipment.—The Safety Car Heating & Lighting Company, 2 Rector street, New York, has issued a 28-page book as a reference for the man who operates "under-frame" equipment. It is called Operation of Safety "Under-Frame" Car Lighting Equipment. The object of the book is to state briefly and concisely the essential points regarding the installation and operation of "under-frame" dynamos and type F regulators. The first part is given over to such subjects as installation of dynamo and suspension, lining up dynamo, belt lengths, measuring of belt lengths, application of belt fasteners, care of under-frame suspension, operation of Safety type F dynamo regulator, method of adjusting automatic switch with car in yards, etc. The latter part of the book is given over to assembly and detail drawings and each detail part is numbered and named. The book is complete and well worth the attention of any one interested in car lighting equipment.

Railway Mechanical Engineer

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CONTENTS

The Trying Times During Readjustment

The men in supervisory capacities on American railroads are being put to a test by what may be considered not necessarily a period of reconstruction, but the result of conditions occasioned by the war. The manner in which these men meet these new problems will show the stuff they are made of. We all well appreciate how the conditions have changed, we all know also that certain changes must come if railroading is to be conducted along economic lines. It is the broad and far-sighted man who sees in these present conditions a swing of the pendulum towards the reactionary and who will foresee its return swing towards more stable and logical conditions. The war has wrought changes in old-time methods of railroading, which, under ordinary circumstances, would have taken years to bring about. Some of these changes have come to stay, others have not. We must take the good from what has come and learn our lessons from the bad. It is no time to give way to discouragements nor to have a spirit of hopelessness. We all must realize that what is fundamentally wrong will eventually be corrected, and everyone must put his shoulder to the wheel to correct the wrong and to further that which is right. Form your own conclusions as to what is right and best and have the courage of your convictions.

Give More Attention to Lumber

In buying steel, the railroads specify within the narrow limits the allowable percentage of impurities and the physical properties required and tests are conducted to insure that the material meets the specifications. Lumber, on the other hand, is usually bought without any precautions being taken to insure that it will have the necessary strength and lasting power, although the properties of different specimens from the same species of wood may vary widely considering the large sums the railroads spend for lumber for use in cars, the scant attention that has been given to its selection and to methods of getting the maximum service from the material is remarkable.

Often-times some of the common practices in purchasing lumber that have been in effect for years, can profitably be changed. For example, one road has found it advisable to specify No. 1 common for sills, even though it is necessary to cull out almost one-third of the material and use it for sill splices, draft timbers, etc. The same road has also found that by reducing the customary allowance of one-half inch for finishing on sills, side plates and other long timber, about eight per cent is saved. These instances will serve to show that a consideration of the methods of buying timber now in use may reveal possibilities for effecting considerable savings.

Coaling Stations Affect Fuel Consumption

The conservation of fuel is a matter that on most roads is handled by the mechanical department. It is probably due to this fact that the greatest attention is paid to methods of saving through improvements in the motive power, while the preparation of the coal and the operation of the fuel stations receive only passing consideration. The importance of the proper operation of fuel stations in securing the economical use of coal, was strikingly brought out at a recent meeting of the Western Railway Club by J. G. Crawford, who presented data to show that if the plants were improperly operated, as much as six per cent of the fuel might be wasted.

To secure the best grade of fuel for locomotive service as delivered on the tender, the coal loaded at the mine must be checked to insure that the lump and screenings are well mixed, the metal bottoms of the coal pockets must be kept bright, and each pocket must be completely emptied every few days. If these precautions are observed, the engines will receive a fairly uniform grade of well cracked mine run coal. On the other hand, if the chute pockets are not cleaned thoroughly and systematically, the metal bottoms will become rusty, and coal will accumulate, with the result that some engines will receive egg coal, others cracked mine run, and still others screenings.

The fuel performance under the latter conditions will not be as good as if the engines had received a uniform grade of mine run coal. Tests conducted at the University of Illinois, show that two inch lump coal is 98 per cent as efficient as mine run, and that two inch screenings are 90 per cent as efficient as mine run. It would make no difference whether the two inch lump and two inch screenings were obtained by screening mine run at the mine or whether they resulted through separation of mine run at the coaling station., Therefore, under the first assumed condition, the efficiency of the coaling station would be 100 per cent, and under the second condition, assuming that the engines received one-half the time two inch lump, and the other half, two inch screenings, the efficiency would be only 94 per cent, or the average of 98 and 90 per cent. The amount to be saved by closer supervision of coaling stations will not average six per cent, but nevertheless on most roads it will be found to be a very appreciable item. There are other conditions that make it advisable to give close attention to the coaling plants. There will be more delay to trains and more engine failures where some locomotives receive all lump coal and others all screenings, than if each engine received a uniform grade. Furthermore, the gradual oxidation of accumulations of mine coal which have remained in the chute undisturbed for some time may cause fires due to spontaneous combustion.

Wages of Railway Shop Employees

The New York State Department of Labor issues regularly a bulletin reviewing the labor situation in the shops and factories of the state. A statement of the average weekly earnings in December, 1918, in representative New York state factories, including all employees in both office and shop, indicates that employees in car, locomotive and railway repair shops are among the very best paid shop employees in the state. In December, 1918, their average weekly earnings amounted to $34.07 as compared to an average of $23.18 for 55 industries. Only one other class of employees, those engaged in the manufacture of pig iron and rolling mill products, received a higher weekly wage; these employees earned $37.97 a week. Employees in the boat and ship building establishments received an average weekly wage of $32.01 and those employed in structural and architectural iron work $30.21.

It is of special interest to compare the conditions in December, 1918, with those of December, 1914. In December, 1914, the average weekly earnings for employees in car, locomotive and railway repair shops was $14.34. Employees in 11 other industries received higher wages. For instance, employees in factories making beverages received $18.58; miscellaneous stone and metal products, $18.47; automobiles, carriages and airplanes, $18.07; printing and book making, $17.03; pig iron and rolling mill products, $16.63; boat and ship building, $16.16; structural and architectural iron work, $15.31; flour, feed and other cereal products, $15.10; slaughtering, meat packing and dairy products, $14.88; drugs and chemicals, $14.57; paints, dyes and colors, $14.43. The average of the 55 industries under consideration was $12.56.

In 1915 the railroad shop employees averaged $16.21 per week and were outranked by nine other industries, the average weekly earnings for the 55 industries being $13.49. In December, 1916, the average earnings for the railroad shop employees jumped to $19.28 as compared with an average of $15.51 for the 55 industries. The railroad shop employees were outranked by only three other industries, the best paid workers being those making pig iron and rolling mill products who received an average weekly wage of $21.76. In December, 1917, the railway shop employees advanced to an average weekly earning of $23.10 and, as in 1918, were outranked by only one other industry—pig iron and rolling mill products. The average weekly earnings for the 55 industries in December, 1917, was $17.71.

Doubtless the contrast between the wages received by railroad shop employees and employees in other industries is still more marked in other parts of the country where competition for labor is not so great. The rates for railroad shop employees have been standardized throughout the country and there are undoubtedly many districts where these employees rank as the very highest paid employees in any industry. It would be interesting to know to what extent this is appreciated by the railroad shop employees themselves, and whether they are giving adequate returns for the wages received. If not, energetic measures should be taken to see that they are thoroughly instructed in their tasks and sufficient supervision should be provided to insure a full day's work for a full day's pay. The public generally has watched closely the increased wages given to railroad employees, and it will look to these employees and their officers for increased efficiency and service.

Piecework Being Abolished in Railway Shops

One of the last acts of Director General McAdoo was to issue an order instructing the railroads to have the shopmen vote as to whether piecework should be retained and that the policy of the shops in this respect should be governed by the will of "a substantial majority." Having at the beginning of 1918 given the trade unions entree on all railroads to develop their organizations, and later encouraging them by increasing the hourly wage without granting a corresponding increase in the piecework rate, the results of this ballot could easily be predicted. There is probably today no railway shop operating under the piecework system. If there is we should be very glad to know about it. The New York Central System, on which the piecework system had been successfully operated both from the standpoint of the men as well as the road, has discarded it entirely. The employees on other large systems likewise have ruled piecework out of existence.

There is not a reader of this paper but will appreciate what the discontinuance of piecework means to output and the cost of repairs. After the increases of Supplement No. 4 to General Order No. 27 removed the incentive for the men to work piecework some very interesting data were obtained. One road found that the output was but 60 per cent. as much per man as before the supplement went into effect and 40 per cent. as much work was being turned out per dollar as before. Another road making a comparison of the last three months of 1917 with the corresponding period in 1918 found a decrease of 28.5 per cent. in the car department in the actual earnings of the men based on the piecework rates in effect in 1917. On still another road the average actual piecework earnings of a labor committee man dropped from 59 cents in March, 1918, to 24 cents in October of the same year, for which he received 58 cents. This gives an indication of what has been done in decreasing the output by not giving the piecework rates the same consideration that the hourly rates received.

The economic value of a man to the world at large is governed primarily by three things: namely, the time he devotes to increasing the world's wealth, the diligence with which he does his work during that time and his cleverness in performing it. Under the hourly rate only one of these qualifications is required of the worker—that is, the time he puts into his occupation. Piecework on the other hand not only demands the time of the workman but provides an incentive for diligent work performed in a skilful and able manner. Fundamentally, therefore, we cannot expect as large an output under day work as we might expect under piecework. The incentive for increasing the output of a man, which has been removed by the abolition of piecework, can to some extent be reclaimed by an increase in the supervision, and where labor is plentiful, by the process of elimination and reorganization for the purpose of getting the best men and the most diligent workers in the shop. The piecework system was so generally used in the shops of the railroads, particularly in the car department, that the reorganization and re-education of the supervising forces is necessary. It is this feature that requires the most careful thought by the railway managements today. Under the existing conditions the workmanship of the men must not only be carefully watched, but it will be necessary to see that they give a full day's work for a full day's pay. There is no use crying over spilled milk. We all must make the best of conditions as they exist and the successful man is he who adjusts himself to those conditions and makes the most of them. Pitch in therefore, recognize the task ahead of you and for your own self respect meet it and make the most of it.

Dissatisfaction with Wage Increases

Several anonymous letters have been sent to the *Railway Mechanical Engineer* by our readers commenting on the injustices that have been occasioned by the various wage orders promulgated by Mr. McAdoo during his year's tenure of office as director general of railroads. In practically every case these letters appear to contain true facts, but we cannot use them as it is against the policy of this publication to print anonymous communications in its columns. We know there are injustices, many of them, but injustices must be expected when any attempt is made to solve, along theoretical lines, the question of the compensation of railroad labor as it existed in 1917. The large amount of overtime worked last year and the varying retroactive periods for different classes accentuated the inequalities in readjustments. The supervising forces were, to use the "doughboy" expression, "out of luck," and many of them when the shops are working 10 hours a day will be still "out of luck," but on an eight-hour day basis there will be comparatively few instances where the remuneration of the supervising forces will be out of proportion to the mechanic. For instance, at 68 cents an hour a mechanic working eight hours a day, six days a week, will average $141.44 per month. The gang foreman at a rate of 73 cents an hour will receive $152 per month. This compares very favorably with the rates paid other foremen, these ranging anywhere from $215 to $350 a month. There are some glaring inconsistencies, however, on some roads, in the case of the roundhouse foremen. The men, receiving 68 cents an hour, are required to work only eight hours, while the foremen receiving between $250 and $275 per month are required to work 12 hours. In the case of an average wage of $265 per month, the foremen will actually be working at an hourly rate, based on overtime after eight hours, less than the mechanics under them. Every one will appreciate the importance of the roundhouse foremen's duties and the "grief" they have to bear. It takes a particularly good man to handle the job. Where are the railroads going to get these men if such discriminations are allowed to exist?

The application of the back pay, extending back to January 1, for the workmen, and July 1, for the supervising foremen, has caused the greatest dissatisfaction. In one instance which was brought to our attention the operator of a wrecking train crane received a total income for 1918 of over $4,000, which, of course, was caused by the excessive overtime he put in during that year. His foreman received less than $3,000 for the same period, and if the same overtime obtains during 1919 the crane man will still exceed his foreman. In another case a traveling crane operator handling a crane over seven pits drew $1,100 back pay, while as a general rule foremen received less than half that amount, and so it goes, according to the varying retroactive periods. Take the car inspector: Formerly, at 35 cents an hour, with a 12-hour day and seven days a week, he would average $127 per month. With his increase to 58 cents and for the same working period he received $246 a month, but now with eight-hour shifts he receives an average of $140 a month, an increase of $13 a month.

While it thus seems that the supervising shop forces are pretty well taken care of on an eight-hour day basis, except possibly in the case of some local discrepancy, it would seem from what we have been able to determine that the master mechanics have not been, perhaps, treated as kindly. The importance of their position should not be underestimated. They bear the responsibility of providing power in proper condition for the operation of the trains. By their most loyal support and work was the excellent record of moving trains accomplished last year. They have a difficult and trying position to fill, acting as the intermediary between the mechanical and transportation departments and between the officers and the men. It is by their efforts and tact that interdepartmental relations are properly maintained. It is true that they have not organized as have the shop men and many of the foremen, but that should not stand in the way of their proper recognition.

Present Condition of Freight Cars

While the general statistics available have shown a gradual improvement in the bad order car situation, they do not reflect the actual condition of the freight cars in this country. In fact, it has been stated that freight cars are in a very bad condition. The good record in the number of cars in bad order is due primarily to the fact that during the past year every effort has been made to keep the cars running and, to gain this end, repairs have been made which might come under the head of temporary repairs. Those cars requiring heavy repairs have been neglected and allowed to accumulate. In addition to this many cars reported in good order should be in the repair shop receiving a general overhauling. This hand-to-mouth policy has been carried on for so long that a vast amount of work is now required to build up the available freight car mileage to what it was when the Railroad Administration took over the roads over a year ago.

With the cars distributed all over the country without regard to ownership, as was the case last year, it has been impossible to maintain them in as good condition as formerly. With the railroads in the hands of private owners and with the car service rules such that cars reached their home roads more often, it was possible for the home roads to make improvements and properly repair their cars. Foreign roads without the necessary repair parts are obliged to a certain extent to make make-shift repairs in order to keep the cars moving, and it is not to be expected that the cars will be maintained as well as when they are on the home roads.

H. L. Shipman, equipment inspector of the Santa Fe, in a paper before the Western Railway Club recently stated that formerly there was a normal percentage of from 35 to 40 per cent of the box cars on the home lines, whereas at the present time this percentage has fallen as low as from 7 to 12 per cent. On one particular road in the east this same tendency has been noticed, but the figures are not quite as good. For three years prior to government operatiou that road maintained an average of 52 per cent home cars on its lines, whereas under federal control the average was only 14 per cent. During the same three-year period cars repaired were distributed about equally between home and foreign cars. During 1918 under government control only 22 per cent of the cars repaired were home cars and 78 per cent were foreign cars. This is the chief reason for the cars being in such poor condition.

The problem now is to get the cars home as quickly as possible in order that they may be given proper attention and repaired according to the standards of the owning lines. It is quite important that this be done, not only from the standpoint of the condition of the cars but from the standpoint of the government itself, for, according to law, it is responsible for returning the roads to their owners in as good condition as when they were received. Where $50 to $75 has been spent on the cars in order to get them off the repair track, only to become bad order again within a week or two, anywhere from $400 to $500 must be spent to put these cars back into first-class condition. The wear and tear on the cars has been very hard during the past year because of the congested condition of the railroads and the haste with which the cars passed through classification yards. Charges of careless practices in switching have frequently been made and an enormous amount of damage has been caused by such practices, all of which must be repaired before the car situation will be what it should be. Every effort should be made to correct such practices.

The Railroad Administration realizes the necessity of getting the cars home for proper attention as is indicated by Car Service Section Circular CS-53, which permits the short-routing of cars home, and further by Circular No. 27, recently issued by W. T. Tyler, director of the Division of Operation, which states that the present conditions with respect to car supply present an opportunity for a relocation of equipment more in accord with ownership than has been practicable during war conditions, under which each unit has been used with the sole purpose of meeting the then existing traffic demands, and further, for providing for the return to the owning road when desired for rebuilding or application of betterments, cars which can be put in safe condition for movement at reasonable cost. With these corrective measures taken it is now up to the individual roads to get the cars home and repair them. With the great reduction in traffic requirements and with the availability of cars for repairs, every measure should be taken to repair them. There should be no retrenchment in the purchase of material nor in the working hours of the shop until the car situation has materially improved.

NEW BOOKS

The Starrett Data Book for Machinists. By H. P. Fairfield, J. N. Bethel, H. H. Edge and J. C. Spence, collaborating editors. 177 pages, illustrated, 4½ in. by 7 in., bound in leather. Published by the L. S. Starrett Company, Athol, Mass. Price 50 cents.

As the title of this book implies, it is a compilation of data regarding machine shop practice and the materials of manufacture, arranged in convenient tabular form, to enable the machinist to finish work with a greater degree of efficiency and accuracy. The information is complete and covers a wide range of work and materials used, as well as weights, measurements, speeds, etc. Measuring instruments are illustrated and their uses described. It was the aim of the publishers to make the book of the greatest value to the largest possible number of practical machinists throughout the country, and the four editors were selected not only because of their knowledge of machine shop work, but because each represents a different field with its own peculiar problems and methods. Machinists should find the book of much assistance in their everyday work.

COMMUNICATIONS

INADEQUATE MAIN BOXES

To the Editor:

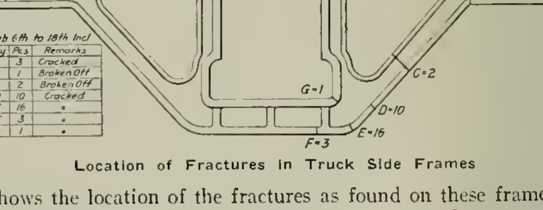
The one defect more than any other, that is knocking out the heavy power on the railroads of this country today is inadequate main boxes. The short sighted policy of equipping the heavy power with main boxes of the same weight, size and bearing as the rest of the driving boxes, has undoubtedly been a serious and costly mistake. I have seen locomotives just out of the repair shop, equipped with new machinery and driving boxes, develop a bad pound in their main boxes, due to worn shells, in less than four months, making it necessary to renew these boxes if it was desirable to keep locomotive in first class condition. You can not have a 100 per cent locomotive when equipped with defective main boxes. There can be no reasonable doubt, that if heavy freight locomotives were equipped with main boxes of a size, weight and bearing commensurate to the power developed in the cylinder of the locomotives, they would run as long without renewal as any other driving box. The loss in efficiency; the cutting out of the rod bushings; the strain on the entire locomotive as well as the cost of repairs, would seem to demand a more adequate main box. In fact, some roads have already begun to equip heavy power with heavier main boxes.
J. H. Buck.

SAFE LIMITS FOR WELDING TRUCK SIDE FRAMES

To the Editor:

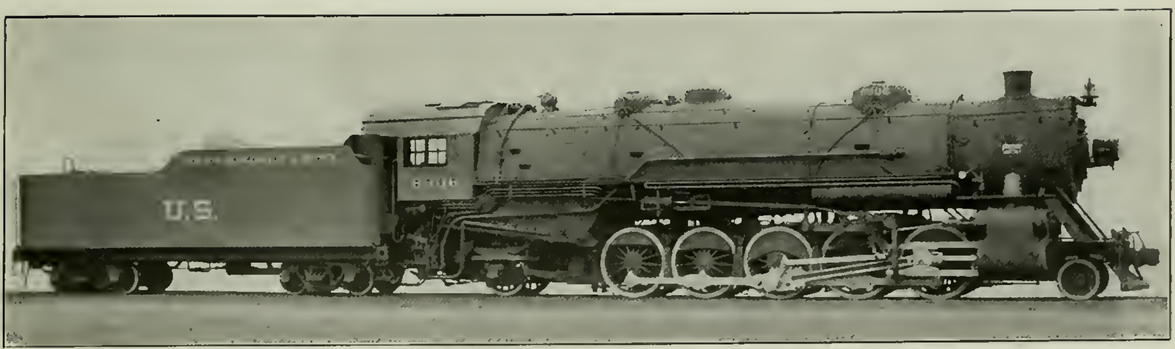
The practice of electric welding car castings has become quite general on most railroads of this country during the past two or three years. There is no question as to the saving that can be effected by this process but there is a question as to how far we can safely go with the electric welding of car castings, especially truck sides and truck and body bolsters. Some roads are limiting the welding to cracks not over 1½ in. in depth, while other roads are welding truck frames, bolsters, etc., that have been entirely broken.

During the past few weeks a record has been kept of the truck frames that have been found cracked and broken under cars arriving at our Kent shops for repairs. The sketch



Location of Fractures in Truck Side Frames

shows the location of the fractures as found on these frames, covering a period of two weeks. A total of 36 frames were found either cracked or broken. The one frame cracked at point *B* had been previously electric welded; the workmanship on this weld had been improperly performed as the casting was not chipped before the welding was done, the welded metal being simply applied to the outside of the casting at the fracture. One of the frames which failed at point *C* had also been previously electric welded in a similar manner. The fractures on these frames varied from ½ in. to 2 in. deep. Only a few frames were found where the fracture extended into the web of the casting. It would be interesting to learn whether other roads have had similar trouble with welded side frames.
W. W. Warner.



Standard Heavy 2-10-2 Locomotive

Heaviest Administration Single Unit Type; Total Weight 380,000 lb., Tractive Effort 74,000 lb.

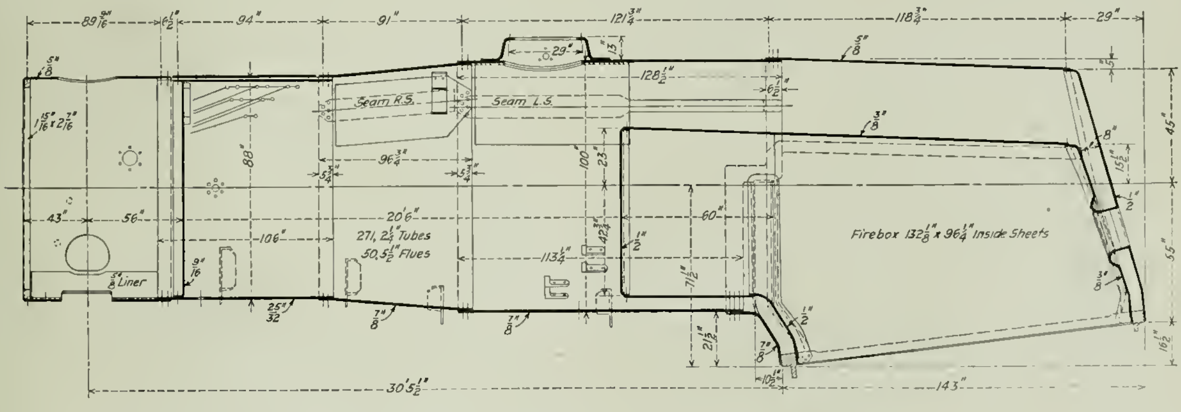
THE first locomotive of the Railroad Administration's standard heavy 2-10-2 type was recently completed at the Brooks Works of the American Locomotive Company for the Chicago, Burlington & Quincy. This locomotive was designed on the basis of driving axle loads of 60,000 lb. and has a total weight on drivers of 293,000 lb. The total weight of the locomotive in working order is 380,000 lb. and it is capable of exerting a calculated maximum tractive effort of 74,000 lb.

The design of this locomotive possesses no unusual features, the type of details throughout being similar to those used in the construction of other standard locomotives which already have been described. Interchangeability of parts between the various types has been effected wherever stresses and dimensions would permit. The relation of boiler capacity to the cylinder demand, calculated in accordance with Cole's ratios, shows ample boiler capacity both as to heating surface and grate area. The steam generating capacity is 104 per cent of the cylinder demand at a piston speed of 1,000 ft. per minute; the size of grate also shows up favorably, the ratio being 102.3 per cent.

As this is the heaviest single unit type of freight locomotive included among the Railroad Administration's standards it is of interest to compare it with a number of other heavy locomotives of the same type. By an inspection of the table it will be seen that it can by no means be ranked among the heaviest or most powerful 2-10-2 locomotives which have been built, although there have probably been none of better balanced design from the standpoint of boiler capacity.

The boiler barrel is of the telescopic type, with an outside diameter at the first course of 88 in., increasing to a maximum diameter of 100 in. There are three courses, the middle one of which is conical; the third course is 113¼ in. in length and the dome is located on this course.

The firebox includes a barrel combustion chamber, the tube sheet of which is 60 in. ahead of the throat sheet, thus providing for tubes 20 ft. 6 in. in length. The firebox is fitted with a brick arch carried on five tubes and is fired by a Hanna mechanical stoker. Other equipment includes the Franklin butterfly firedoor and power gate shaker.

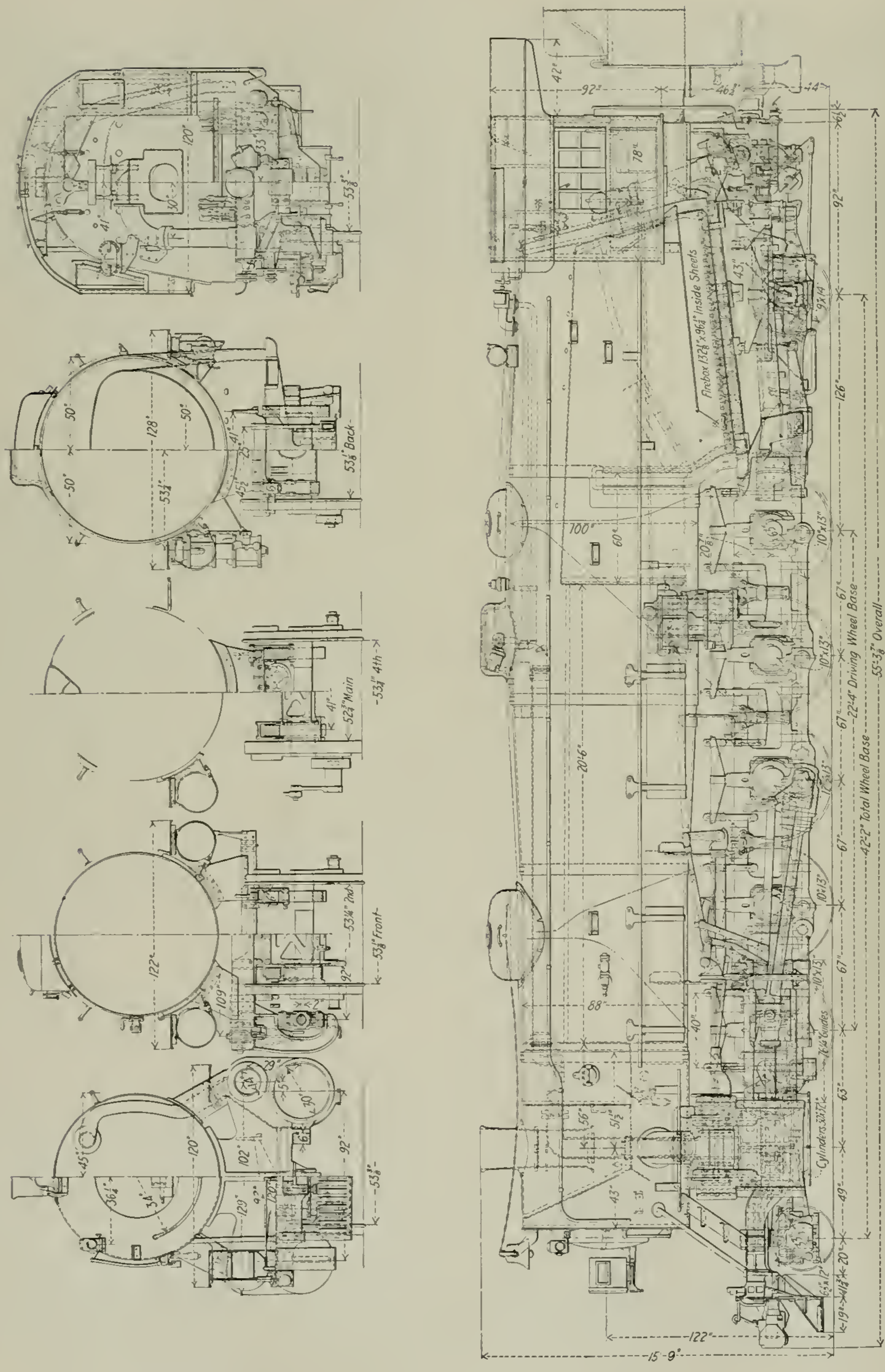


Longitudinal Section of the Standard Heavy 2-10-2 Type Boiler

The tube sheet is laid out for 271, 2¼-in. tubes and 50, 5½-in. flues for a 50-unit type A superheater. The tubes are spaced ¾ in. apart while the flues are one inch apart.

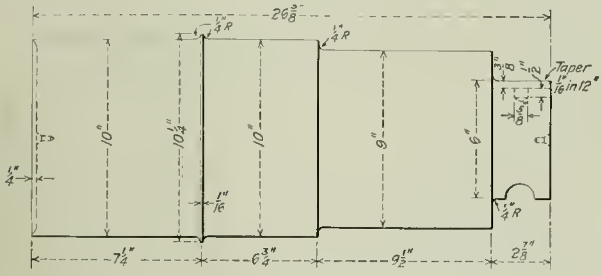
The general features of the frame design are identical with those of other single unit standard locomotives. The cylinders are carried on a single front rail cast integral with the main frame, and a Commonwealth cradle casting is spliced to the main frames just back of the rear driving pedestals.

The frames are six inches wide and have a maximum depth of top rail of 8⅜ in. over the pedestal jaws. The minimum depth of the top rail is seven inches. The maxi-



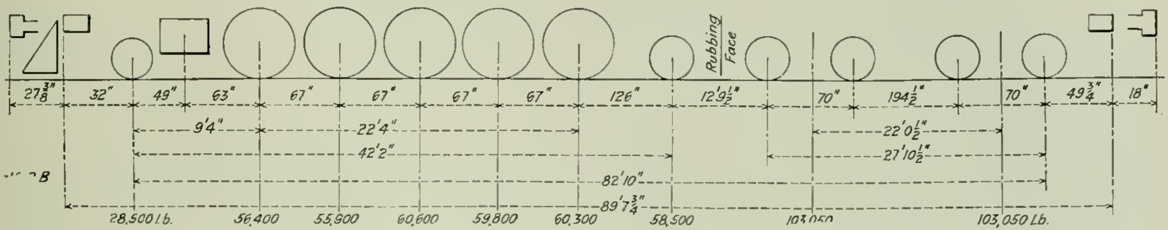
Elevation and Sections of the United States Railroad Administration Standard Heavy 2-10-2 Type Locomotive

mum and minimum depths of the lower rail are 5½ in. and 5 in., respectively. The front rail under the cylinders is six inches wide and tapers from a depth of 12¾ in. at the rear to 11½ in. at the front of the cylinder fit.



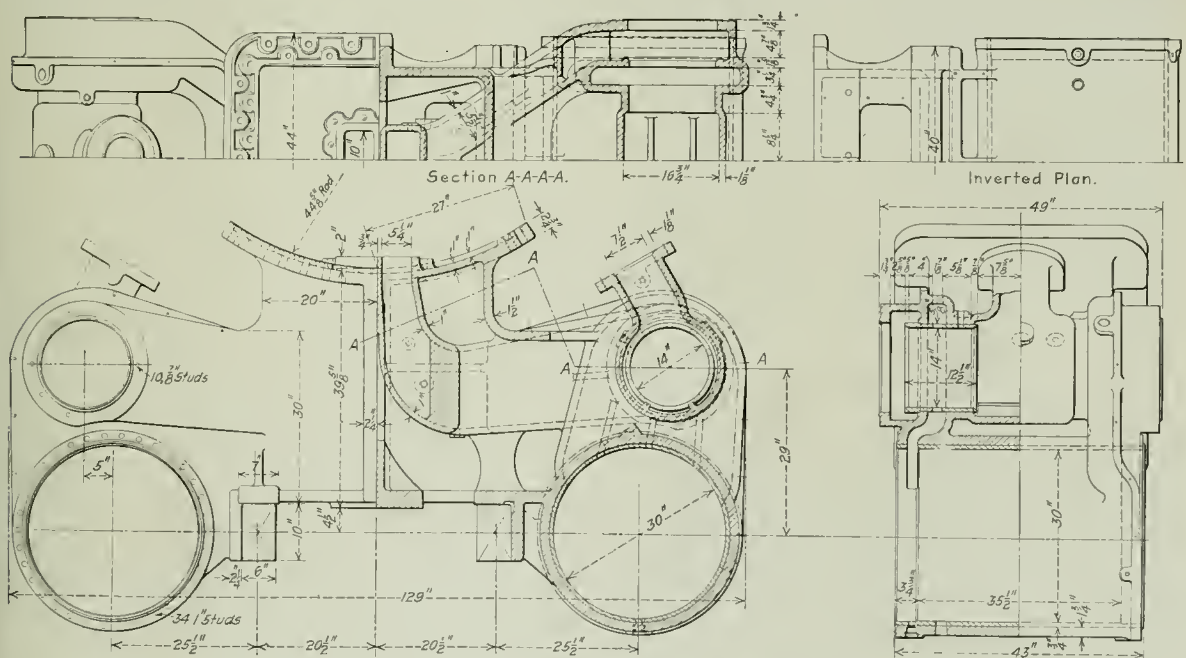
The Main Crank Pin for the Railroad Administration Heavy 2-10-2 Type Locomotive

The driving axles have journals 10 in. in diameter by 13 in. in length with the exception of the main, the diameter of which is 12½ in. The axles and driving boxes having



Wheel Loading Diagram of the Standard Heavy Santa Fe Type Locomotive

the 10-in. journals are interchangeable with those of the same journal size on other standard types of locomotives. This



Cylinder for the Standard Heavy Santa Fe Type Locomotive

includes the light 2-10-2 type and both the light and heavy Mikado type locomotives. The drawing of the main crank pin illustrates the type of pin used in all the standard locomotive designs. The engine truck under these locomotives is of the constant resistance type and is identical with that used on the 2-6-6-2 Mallet type locomotive. A number of the

A Comparison of Heavy 2-10-2 Type Locomotives

Road	U.S. Std.	Pa. Lines	D. & R. G.	Erie	N.Y.O. & W.
Year built	1918	1918	1916	1916	1916
Tractive effort, lb.	74,000	80,900	81,200	83,000	71,200
Total weight, lb.	380,000	435,400	428,500	401,000	353,500
Weight on drivers, lb.	293,000	351,300	337,500	335,500	298,500
Diameter of drivers, in.	63	62	63	63	57
Cylinder diameter and stroke in.	30x32	30x32	31x32	31x32	28x32
Steam pressure, lb. per sq. in.	190	205	195	200	190
Heating surface, total evap., sq. ft.	5,156	4,725	5,369	4,959	4,498
Heating surface, equivalent,* sq. ft.	7,001	7,152	7,362	6,870	6,009
Grate area, sq. ft.	88.2	80.0	88.0	94.8	80.2
Tractive effort x diam. drivers ÷ equiv. heating surface*	665.9	701.7	695.0	760.0	677.0
Firebox heating surface ÷ equiv. heating surface,* per cent	6.3	5.2	5.0	5.0	5.4
Grate area ÷ volume cylinders	3.3	3.1	3.2	3.4	3.5

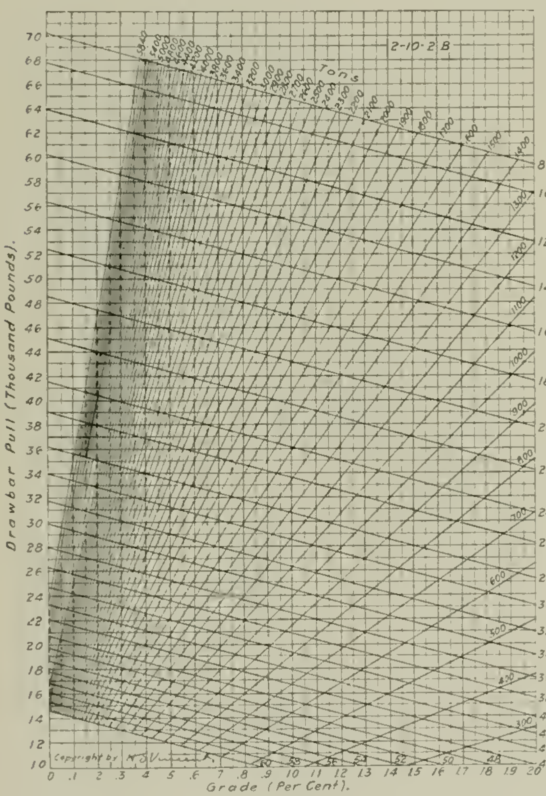
*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

engine truck details, including the center pin, pedestal, pedestal crosstie, swing bolster, swing frame and link are also identical with those used on the trucks of both Mikado type locomotives and the light Santa Fe type. With the exception of the radius bar these details are also used on the light Mallet locomotive.

The trailer truck is of the Cole-Scoville type and as a whole is not interchangeable with any other class of locomotives. The frame, however, is identical with that used under the light Santa Fe type, both Mikados and the light Mallet locomotives.

The cylinders are shown in detail in one of the illustrations, and are typical of those on the other classes of single unit type engines. They are 30 in. in diameter with a stroke of 32 in. and are fitted with pistons of single plate dished section similar in design to those used on all the standard locomotives. The valve chambers are designed for the use of 14-in. piston valves. As on the other standard locomotives Hunt-Spiller gun iron is used for cylinder and valve chamber bushings, piston and valve bull rings and packing rings, and crosshead shoes. The steam distribution of these locomotives is effected by the Southern valve gear and the locomotive is fitted with the Lewis power reverse gear.

Among the principal specialties with which these loco-



Tonnage Rating Chart Prepared for the Standard Heavy 2-10-2 Type Locomotive

motives are equipped are Chambers backhead type throttle, Ashton 3½-in. open safety valves, Hancock No. 13 non-lifting injectors, Everlasting blow-off cocks, Detroit six-feed lubricators, Barco flexible pipe joints and Radial buffers and Unit safety bar between the engine and tender.

The tonnage rating diagram was prepared and is copyrighted by H. S. Vincent. The curves of hauling capacity are constructed for a car resistance of four pounds per ton. The chart may be used for any other car resistances by converting them into terms of grade as follows:

1 lb. car resistance	=	.05 per cent grade
1 deg. curve uncompensated	=	.04 per cent grade

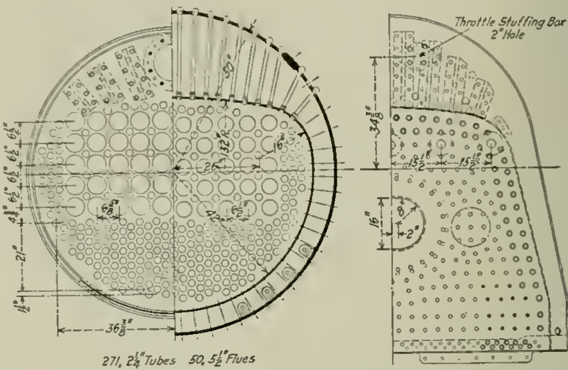
For example, find the tonnage capacity of the locomotive at 20 m. p. h. on .6 per cent grade combined with five-degree uncompensated curve and with a train resistance of five pounds per ton.

The combined resistance in terms of grade is:

$$.6 + (5 \times .04) + (1 \times .05) = .85 \text{ per cent.}$$

At the intersection of the ordinate for .85 per cent grade with the drawbar pull curve for 20 m. p. h. we find 2,100 tons as the capacity of the engine.

The clearance and wheel loading diagrams were prepared in the office of F. P. Pfahler, chief mechanical engineer of the Division of Operation of the Railroad Administration.

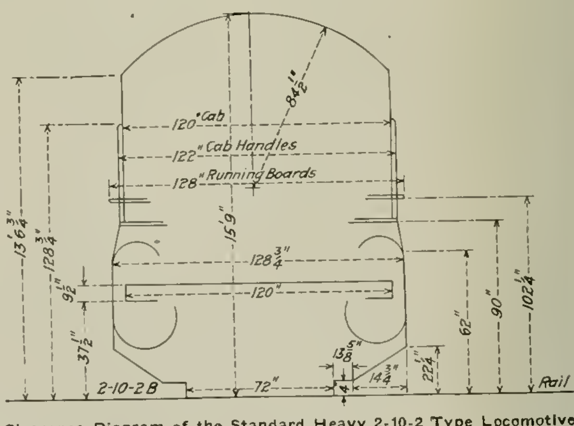


Half Elevations of the Back Boiler Head and Front Tube Sheet and Half Section Through the Combustion Chamber

The weights shown on the wheel loading diagram are actual. Other data and dimensions for this locomotive are as follows:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	74,000 lb.
Weight in working order	380,000 lb.
Weight on drivers	293,000 lb.
Weight on leading truck	28,500 lb.
Weight on trailing truck	58,500 lb.



Clearance Diagram of the Standard Heavy 2-10-2 Type Locomotive

Weight of engine and tender in working order	586,100 lb.
Wheel base, driving	22 ft. 4 in.
Wheel base, total	42 ft. 2 in.
Wheel base, engine and tender	82 ft. 10½ in.

Ratios

Weight on drivers ÷ tractive effort	4.0
Total weight ÷ tractive effort	5.1
Tractive effort × diam. drivers ÷ equivalent heating surface*	665.9
Equivalent heating surface* ÷ grate area	79.4
Firebox heating surface ÷ equivalent heating surface,* per cent	6.1
Weight on drivers ÷ equivalent heating surface*	41.9
Total weight ÷ equivalent heating surface*	54.3
Volume both cylinders	26.4 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	265.2
Grate area ÷ vol. cylinders	3.3

Cylinders

Kind	Simple
Diameter and stroke	30 in. by 32. in.

Valves	
Kind	Piston
Diameter	14 in.
Greatest travel	7 in.
Steam lap	1⅛ in.
Exhaust clearance	Line and line
Lead in full gear	3/16 in.
Wheels	
Driving diameter over tires	63 in.
Driving journals, main, diameter and length	12½ in. by 13 in.
Driving journals, others, diameter and length	10 in. by 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.
Trailing truck, journals	9 in. by 14 in.
Boiler	
Style	Con. wagon top
Working pressure	190 lb. per sq. in.
Outside diameter of first ring	88 in.
Firebox, length and width	132⅛ in. by 96¼ in.
Firebox plates, thickness	Sides, back and crown ⅜ in.; tube, ½ in.
Firebox, water space	Sides and back, 5 in.; front, 6 in.
Tubes, number and outside diameter	271—2¼ in.
Flues, number and outside diameter	50—5½ in.
Tubes and flues, length	20 ft. 6 in.
Heating surface, tubes	3,258 sq. ft.
Heating surface, flues	1,469 sq. ft.
Heating surface, firebox	429 sq. ft.
Heating surface, total	5,156 sq. ft.
Superheater heating surface	1,230 sq. ft.
Equivalent heating surface*	7,001 sq. ft.
Grate area	88.2 sq. ft.
Tender	
Tank	Water bottom
Frame	Cast steel
Weight	206,100 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	12,000 gal.
Coal capacity	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

The Resistance of Materials

The Effect of Sudden or Abrupt Changes in the Section on the Distribution of the Unit Stresses

BY G. S. CHILES AND R. G. KELLEY

I

In the testing of sample or test pieces of material for the purpose of determining its various properties such as tensile strength, etc., it has long been recognized by engineers that the actual stretch or extension of the test specimen as well as the value obtained for its ultimate strength is affected to a considerable extent by its general form or contour. It is also quite generally understood, that in pulling specimens in a testing machine, it is of prime importance to maintain a truly axial pull, since otherwise an undesirable bending stress is set up which affects to a greater or lesser degree the results obtained. These facts have become more in evidence as the use of the extensometer or strain gage has gradually become more extensive; two strain gages attached to the opposite sides of a test bar often exhibit a considerable variation in readings due to the presence of a bending stress.

As a general rule these facts have been recognized and accepted merely as a characteristic feature of the testing of materials and have not been taken into consideration or put into practical application to any great extent in the actual design and construction of members employed in engineering structures and machines. As a matter of fact, this time-honored practice of applying values determined from tests upon specimen bars whose form is such that they will offer the maximum resistance, to the design of actual details admits of more or less inaccuracy and may be entirely misleading as regards results desired, since the form which offers the maximum resistance can seldom be utilized. When, however, it is desired merely to make comparisons of the relative resistances of different materials, the employment of test bars of such form provides a convenient means of obtaining accurate data.

The object of this article is to review briefly some of the data relative to the effect of abrupt changes of section under "static" and "dynamic tests" which has already been presented by various authorities and also to submit the results of some additional experiments dealing with this phase of engineering science which were carried out by the writers. While these experiments were not performed with such a degree of exactness as to permit of the derivation of formulae or laws, it is hoped the results will contribute in some small degree to the store of information relative to this subject by visualizing the mechanics of stress distribution.

It is customary in designing members in which there are sudden or abrupt changes of section such as bars, plates, etc., having drilled or punched holes, threaded bolts, or members similar to those shown at *a*, *b* and *c* in Fig. 1, to employ as the working value of the fibre stress the value for the average fibre stress determined by dividing the axial load in pounds by the minimum cross-sectional area expressed in terms of square inches. This practice is based upon the assumption that the distribution of stress is uniform throughout the section. However, for values up to the elastic limit of the material, a point which is considered by some engineers to represent the maximum desired range of stress, the stress is not uniformly distributed over the cross section but is considerably greater at some points thereof than at others, especially at parts which embody a rapid change of form such as a cross section immediately adjacent to the edge of a hole or to a boss or a shank. This non-uniform distribution of stress also occurs in irregular, curved or abrupt sections or surfaces. Due to the fact that the intensity of the stress is greater at the edge of a restricted area, the material at that point will be stressed beyond its elastic limit at a lower value of the total load than would be the case were the change from the larger to the smaller section made more gradual and less abrupt.

EFFECT OF GENERAL FORM ON ULTIMATE STATIC STRENGTH

In the case of good test specimens of ductile materials, such as wrought iron and mild steel, the flow of metal preceding rupture and causing local contraction of section often extends longitudinally over a distance of from six to eight times the diameter or width of section. The process of failure under a static test is a gradual one due to the progressive breaking down of the material as the maximum stress is transmitted from point to point upon the yielding of the metal under the increasing load thrust upon it by the failure of the metal at some other part of the cross section to withstand the stress to which it is subjected. In the case of steel, the part of the cross section which is subjected to the greatest stress intensity will yield first, throwing a portion of its load upon the material in the remaining portions. As the particles successively fail the load upon the remaining particles is continually increased in amount and the process of failure gradually becomes accelerated. As, under similar conditions, the same action takes place in members other than test specimens, this explains why in some instances members in which the length of reduced sections are short as compared to the transverse dimensions require a greater load to cause failure under a static test than members having similar reduced sections which have a greater ratio of length to transverse dimensions. The process of metallic flow becomes more difficult as the length of the reduced section is shortened and, in general, the value of the breaking load is increased.

The importance of the size of the test piece has long been recognized and is usually specified so as to afford a fair comparison of results.

The foregoing will explain why it is desirable when convenient to specify that the form of the specimen bars which are to be submitted for static tests shall be such that the length of the test section is not less than from eight to ten times the greatest transverse dimension and, in the case of bars having enlarged ends, that the change of section shall not be abrupt. Although due consideration is usually given to the form of the specimen and the effect of its general form upon the values determined by the static test, these features are frequently disregarded in the actual design and fabrication of the various members which are to constitute the structure or the machine.

A common instance of this may be found in the case of riveted joints, where the metal left between the holes is usually subjected to tensile stress. It has actually been determined by experiment that the metal in these sections will support a greater load per square inch of cross-sectional area under static test than a full section elsewhere in the same specimen, which is of sufficient length to permit of free local flow. Kennedy in a report on riveted joints before the Institute of Mechanical Engineers * produced evidence to the effect that the tensile strength of a strip of mild steel plate in which a number of holes had been drilled might reach a value as high as 12 per cent greater than that of an undrilled strip. Where the holes are punched instead of drilled it appears that the remaining metal adjacent to the holes is greatly weakened. It is distorted and overstrained by the shearing action and is rendered less capable of plastic deformation due to the hardening effect of the overstrain.

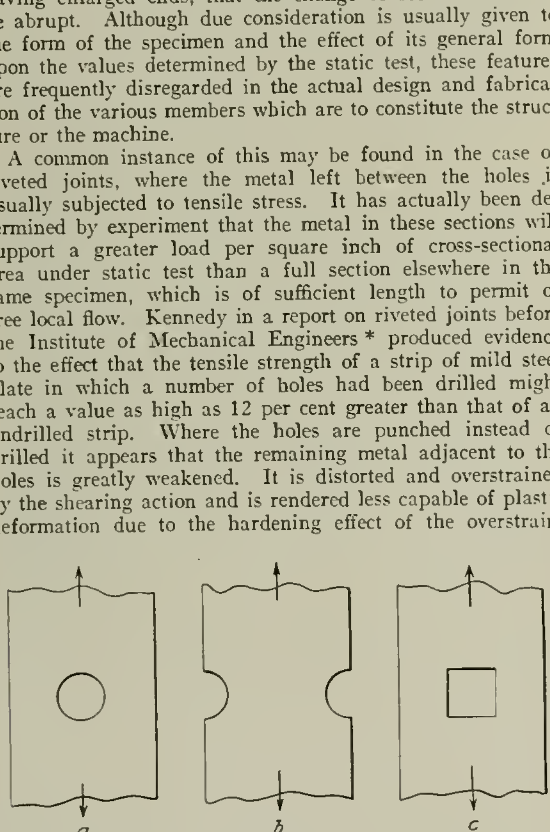


Fig. 1

The hardened portion thus receives an undue proportion of the stress and the strip will fail under a smaller load than it would were the stress uniformly distributed over the cross-section. This is a case of ductile and non-ductile material in the same cross-section.

The ultimate strength of members having irregular or abrupt sections under a static test becomes, then, in a measure a function of the ductility of the material. For non-ductile materials such, for example, as cast iron, fracture will occur at or near the minimum section as a result of the unequal distribution of stress. In the preceding discussion the two statements, "will support a greater load" and "will fail under a smaller load," it should be remembered, dealt respectively with ductile material which had not been overstrained, and with material which had been overstrained by punching the holes, thus acting more like non-ductile material. In the case of ductile materials, although the first deformation will take place at those localities where a restriction of sectional area occurs, *i. e.*, the edge of a hole, an edge adjacent to a boss, or an enlargement of sectional area, rupture under static test will be apt to occur at some cross-section other than that having the greatest stress, for the reason that at or near this cross-section the contraction

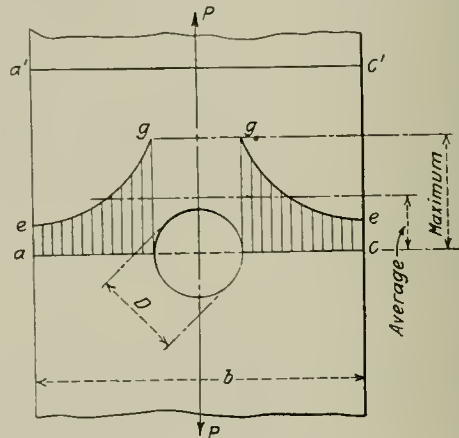


Fig. 2

of sectional area which precedes rupture is prevented to a considerable extent by the projecting sections of the member.

The tensile strength is reckoned on the original area of the test piece and not on the final area at the point of fracture. If we would term the tensile strength based upon the original area the nominal tensile strength and the real tensile strength the value obtained by using the area at the moment of fracture, then the difference between the nominal and the real tensile strength would depend upon the reduction in area. If we could prevent the test specimen from contracting, we would raise the nominal tensile strength and this is really what happens in a perforated bar or one having an abrupt change of section. Since only ductile materials have an appreciable contraction of area the above applies only to ductile material. In non-ductile or only slightly ductile material the perforated strip, when pulled in a testing machine, will usually break through the hole and the total pull will equal the product of the net area of the section by the tensile strength of the metal.

It should be remembered that the test pieces under discussion above have a non-uniform stress distribution due to their generally irregular or abrupt form. In the ductile material plastic deformation would take place and cause a uniform stress distribution but this is prevented or retarded by the irregular form. In the non-ductile material, there being practically no plasticity or local flow the stress distribution does not become uniformly distributed and the particles soon start to fail at the high stress point. This is more of a progressive break as explained above.

STATIC TESTS AND ACTUAL SERVICE TESTS

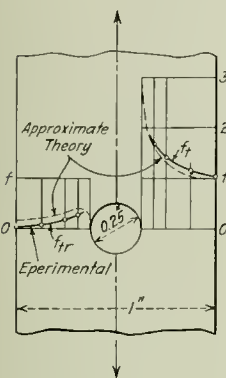
As regards the action of materials when subjected to those tests which, for convenience, we will style dynamic, or tests in which the specimen is subjected to the action of intermittent forces whose frequency of application varies more or less rapidly with time, the results are somewhat different.

*See Proceedings of the Institute of Mechanical Engineers, 1881-1885.

Materials whose properties as determined by ordinary static tests may indicate that their use is entirely justified yet fail or otherwise prove unsatisfactory in actual service.

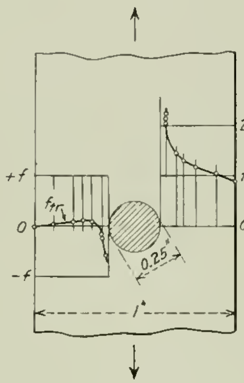
Wöhler, in his classical experiments, clearly demonstrated that loads which were sufficient to produce only a moderate amount of permanent set even when allowed to remain in action for an indefinite period of time, would eventually cause failure if applied and removed at frequent intervals. He further found that by alternately applying loads of opposite sign, such as alternating a tension load with a compression load, the period of time required for failure was shortened.

The experiments of Wöhler and others show that a steel



With Hole.

Fig. 3



Hole Fitted with Pin.

Fig. 4

bar having an ultimate strength of 60,000 lb. per sq. in., if loaded from zero to 40,000 lb. will probably break after a few thousand applications. If the upper limit is reduced 5,000 lb., so that the load varies from zero to 35,000 lb., the bar will withstand a much larger number of load applications; if this range of stress is reduced 5,000 lb. more, say from zero to 30,000 lb., it may take several million repetitions to cause failure and if loaded from zero to 25,000 lb. it will perhaps last indefinitely. If the stress varies from 25,000 lb. to 40,000 lb. per sq. in. the bar will also last indefinitely. Similar steel subjected to a stress which changes from 16,000 lb. compression to 16,000 lb. tension will fail, but if the stress changes from 14,000 lb. compression to 14,000 lb. tension the piece will probably stand an indefinite number of repetitions.

It is evident, then, that the strength of a material as determined by an ordinary static test is but one of several properties which may be essential to meet actual service requirements and it is by no means a correct indication of the ability of such materials to resist shocks or alternating loads. Thus while members having abrupt changes of general form, such as bolts and especially bolts with rolled threads, frequently fail under static loads at sections other than at the root of threads, in service failures which are brought about by gradual deterioration of the metal known as "fatigue," fracture usually occurs at those localities in which there is a sudden reduction of sectional area and under loads lighter than would be necessary to produce failure in a static test.

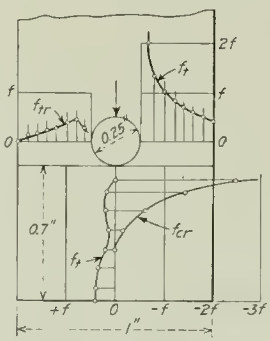
Static tests of arch bar trucks, when carried to failure, almost universally result in shearing the journal box bolts. In actual service failures it is the bottom arch bar which almost always fails, in the majority of cases at the lower radius near the column casting, although occasionally it fails at other sections and a few failures occur in the top arch bar. Many railway men with years of experience testify they have never known of a case of the journal box bolts actually shearing in service, yet if the static tests were accepted as indicative these bolts are the very parts that should be strengthened.

STRESS DISTRIBUTION IN TENSION MEMBERS

The effect upon the stress distribution across the section of a tension member, of a hole drilled through the member has been carefully investigated by several authorities. The stress diagram, Fig. 2, represents graphically the results obtained by Preuss * in the course of an investigation relative to the effect of a punched hole upon the stress distribution across the section of a flat bar. The hole, of diameter D, was centrally located, and the tension was exerted along the vertical axis of the bar of width b. The ordinates under the curved line eg represent the stresses at any point across the section of the bar. Preuss ascertained that the maximum stress, which occurs at the edge of the hole, is not materially affected by the magnitude of the diameter of the hole and that it is from 2.1 to 2.3 greater than the value obtained for it on the assumption of uniform stress distribution throughout the section most weakened by the punched hole. He also found that the minimum stress, which occurs at the outer edge of the bar, decreases as the diameter of the hole is increased.

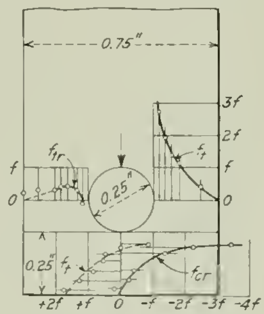
Professor Croker and Lieutenant W. A. Scoble of the Royal British Navy, have investigated (1) the stress distribution across the section of a tension member having a drilled hole, (2) the stress distribution when the hole in the tension member was fitted with a pin, and also (3) the stress distribution when the load was applied through the pin.

Figs. 3, 4, 5 and 6 are reproduced from a paper on "The Design of Pin Joints Based on Ultimate Strength"† by Lieutenant Walter A. Scoble, R. N. V. R., which appeared in *Engineering*, London, April 20, 1917. In Fig. 3 case (1) is illustrated, a plate tension member of one inch width having a 0.25-in. hole drilled at the center of its width. The intensities of the stresses across the narrow section of the test specimen, indicated by the line *oo* through the center of the hole, are plotted from *oo* as a base. The longitudinal



Case 1.
Load Applied by Pin.

Fig. 5



Case 2.
Load Applied by Pin.

Fig. 6

stress on the section *oo*, that is, the tension in the same direction as the pull, is indicated by the curve f_t at the right of the hole. The stress at right angles to the longitudinal stress, is denoted by the curve f_{tr} at the left.

Instead of the uniform distribution of stress usually assumed in such cases by the designer, the stress intensity is variable across the section and increases from the edge of the plate to the edge of the hole, where it may reach a value three times as great as the stress intensity at the edge of the

*Experiments on Distribution of Stresses in Punched Flat Bars, Zeits des Vereins Deutsches Ingenieure, Vol. 56, No. 44.

†Paper read at the Institution of Naval Architects, March 28, 1917.

plate. For the ratio of this maximum stress to the mean value of the stress across the entire section they find that their results for one central hole may be expressed as

$$\frac{\text{Maximum stress}}{\text{mean stress}} = \frac{3C}{C+1}$$

where C is the ratio of the plate width to the hole diameter.

The value of the longitudinal stress on a normal section of the plate at any distance l from the center of the hole might otherwise be stated as

$$f_{(l)} = \frac{f}{2}\left(2 + \frac{r^2}{l^2} + \frac{3r^4}{l^4}\right)$$

where f is equal to the mean value of the stress over the entire width of the plate and r is the radius of the hole. From the above it will be noted that at the edge of the hole, where r equals one, the longitudinal stress is

$$f_{(l)} = 3f,$$

or three times the mean value of the stress over the entire width of plate.

The longitudinal stress is accompanied by a stress at right angles, having a value which may be expressed as,

$$f_{(r)} = \frac{3f}{2}\left(\frac{r^2}{l^2} - \frac{r^4}{l^4}\right)$$

At the edge of the hole, where r and l are each equal to unity, the radial stress is zero.

In the course of an investigation of this phenomenon Prof. Croker and Lieutenant Scoble carried out a series of tests upon a bar one inch in width and 0.186 in. in thickness and perforated with a drilled hole whose diameter was gradually increased for each test. The load, in each case, was 100 lb. and the results obtained are presented in Table I.

Table I.

Test No.	Diameter of hole at center of bar, in.	Stress values in lb. per sq. in. $f_{(l)}$	f	$f_{(eh)}$
1	1/16	549	584	1,470
2	1/8	547	620	1,560
3	1/4	568	724	1,770
4	3/8	570	868	1,850
5	1/2	613	1,035	2,040

Note
- $f_{(l)}$ = stress at a long distance from centre of hole.
- f = mean value of stress over entire width of section.
- $f_{(eh)}$ = stress at the edge of the hole.

In Fig. 4 a tension specimen similar to the one shown in Fig. 3 was used except that the central hole was fitted with a pin. This specimen was then subjected to pull as in the previous test. The longitudinal tension, through the section *oo* was very similar to that found in the specimen with the hole not fitted with a pin. The pull on the plate caused the plate to press on the pin and the radial stress at right angles to the longitudinal stress was changed. Near the pin the plate is now in compression changing to tension a short distance out. Compression is shown below *oo*, tension above.

In Figs. 5 and 6 the tension, instead of being caused by a pull on the test specimen as in the two previous cases, was due to a load applied to the ¼-in. pin. In Fig. 5 the pin was small compared to the breadth of the plate and a considerable amount of overlap (0.7-in.) was allowed. The longitudinal tension or axial tension, f_t above *oo*, across the narrow section *oo* varies still more than in the previous cases. The section directly below the hole was also investigated and a very intense compression, f_{cr}, was found where the pin pressed on the plate. This compression diminishes rapidly as the distance from the edge of the hole increases, disappearing at about half way from the edge of the hole to the edge of the plate. The tangential stress, f_t, below *oo*, or the stress parallel to *oo* is not very high in this case.

In Fig. 6 the diameter of the hole is greater compared to the breadth of the plate, the plate in Fig. 6 being only 0.75 in. wide as against one inch in Fig. 5. The amount of the overlap is also less, being 0.25 in. The axial tension, f_t above *oo*, across the narrow section is greater at the edge of the hole than before and becomes zero at the edge of the plate. The radial compression due to the pressure of the pin on the plate, f_{cr} below *oo*, is much more intense, decreasing to zero in this case at the lower edge of the plate. The tangential stress, f_t, below *oo*, from the edge of the pin to the lower edge of the plate is like that across a section of a beam, in that near the hole the plate is in compression, changing to tension about one-fourth of the way down from the hole.

In all the above examples, such as a tension member with hole, or plate fitted with pin the stress distribution was very unequal and the stresses of greatest intensity were localized at the region near the hole.

(*To be continued*)

RAILROAD ADMINISTRATION NEWS

Additions to the payroll of the railroads in 1918, largely as the result of wage increases ordered by the director general, are now estimated at approximately $642,000,000, or about 37 per cent. This, however, is the total increase in the payroll and is affected to some extent by the change in the number of employees. All of the increases, however, were not in effect for the full year and the total on a yearly basis is estimated at $810,000,000, not including the perspective large increase for the train service employees.

OVERTIME NOT CONSIDERED AS SALARY

Interpretation No. 9, relating to general order No. 27, gives a decision on the following question: If an employee covered by the provisions of general order No. 27 and subsequent wage orders issued by the director general in connection therewith, whose salary is $250 or less per month, is required to work overtime, and in a given month his total wage, including overtime, amounts to more than $250, is it the intention to restrict his earnings per month to $250?

The decision is that overtime is not to be considered as salary.

PIECE WORK BEING ABOLISHED

In accordance with instructions issued by Director General McAdoo just before he left Washington the shop employees on the various roads voted on the question of the abolition of the piece-work system. As a result of the vote piece work has been discontinued on the Pennsylvania lines, east and west, Philadelphia and Reading, Baltimore & Ohio, Delaware, Lackawanna & Western, Cumberland Valley, Long Island, New York Central, Norfolk & Western, Chicago, Burlington & Quincy, Michigan Central, Lehigh Valley, Erie, Chesapeake & Ohio, and Central of New Jersey. The Railroad Administration is following a policy of reducing the shop hours at many places where there is a surplus of labor in preference to laying off men, and the Pennsylvania shops at Harrisburg and Altoona, and shops on the Baltimore & Ohio, Hocking Valley and other roads in the Eastern region have been placed on a 40-hour week basis. While the number of employees has been reduced at various shops on many roads, there is still a shortage of men on a large number of roads, and efforts are being made to transfer men from places where there is a surplus to where there is a demand for them. It is stated that places are being made for all returning soldiers and that in some cases they are replacing inexperienced men employed during the war.

CARS TO BE RELOCATED IN ACCORDANCE WITH OWNERSHIP

W. T. Tyler, director of Division of Operation, has issued Circular No. 27, which states that present conditions with respect to car supply present an opportunity for:

(a) Relocation of equipment more in accord with ownership than has been practicable during war conditions, under which each unit has been used with the sole purpose of meeting the then existing traffic demands.

(b) Providing to a greater extent for use by the owner of equipment of its accepted standards.

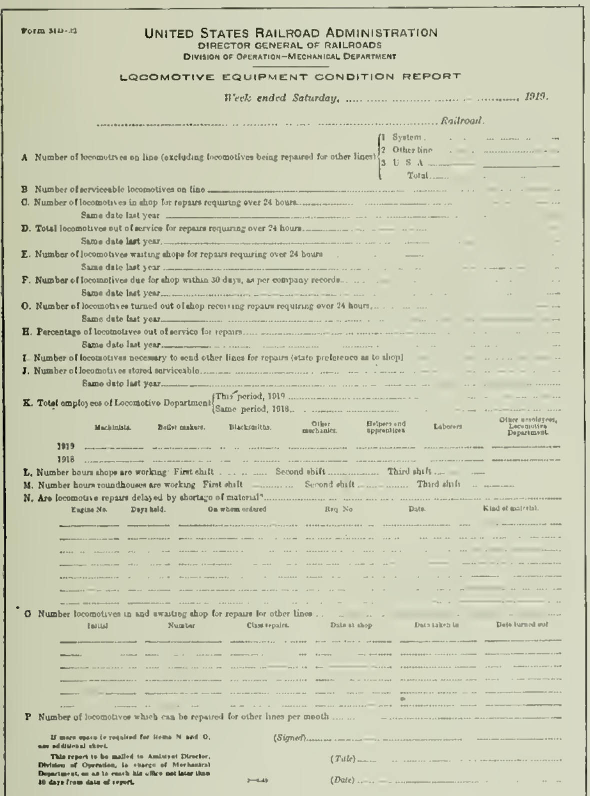
(c) Providing for the return to the owning road when desired for rebuilding or application of betterments, cars which can be put in safe condition at reasonable cost.

To accomplish the above, regional directors are instructed to direct federal managers and all concerned in the proper handling of cars in accordance with the following, without abandoning the principle of common use of cars:

1. In general, cars should be loaded to or in the direction of the home road. This will not apply to cars under direction of the Refrigerator and Tank Car Department of the Car Service Section at Chicago, or those under direction of the Eastern Railroads Coal Car Pool at Pittsburgh.

2. The Car Service Section will, as may be agreed upon with regional directors, relocate equipment according to ownership by regions so far as practicable.

3. The regional directors will then relocate the same cars on the basis of ownership so far as practicable.



Form MD-23

UNITED STATES RAILROAD ADMINISTRATION
DIRECTOR GENERAL OF RAILROADS
DIVISION OF OPERATION—MECHANICAL DEPARTMENT

LOCOMOTIVE EQUIPMENT CONDITION REPORT

Week ended Saturday, ... *1919.*

.... *Railroad.*

A Number of locomotives on line (excluding locomotives being repaired for other lines) 1 System ..... 2 Other line ..... 3 U S A ..... Total .....

B Number of serviceable locomotives on line ....

C. Number of locomotives in shop for repairs requiring over 24 hours....................
Same date last year ....

D. Total locomotives out of service for repairs requiring over 24 hours....................
Same date last year....................

E. Number of locomotives waiting shops for repairs requiring over 24 hours ....
Same date last year ....

F. Number of locomotives due for shop within 30 days, as per company records....................
Same date last year....................

G. Number of locomotives turned out of shop receiving repairs requiring over 24 hours....................
Same date last year....................

H. Percentage of locomotives out of service for repairs....................
Same date last year....................

I. Number of locomotives necessary to send other lines for repairs (state preference as to shop) ....

J. Number of locomotives stored serviceable....................
Same date last year....................

K. Total employees of Locomotive Department This period, 1919 .... Same period, 1918....................

	Machinists.	Boiler makers.	Blacksmiths.	Other mechanics.	Helpers and apprentices.	Laborers	Other employees, Locomotive Department.
1919							
1918							

L. Number hours shops are working: First shift .... Second shift .... Third shift ....

M. Number hours roundhouses are working First shift .... Second shift .... Third shift ....

N. Are locomotive repairs delayed by shortage of material? ....

Engine No.	Days held.	On whom ordered	Req No	Date.	Kind of material.

O Number locomotives in and awaiting shop for repairs for other lines ....

Initial	Number	Class repairs.	Date at shop	Date taken in	Date turned out

P Number of locomotives which can be repaired for other lines per month ....

If more space is required for items N and O, use additional sheet.

This report to be mailed to Assistant Director, Division of Operation, in charge of Mechanical Department, so as to reach his office not later than 10 days from date of report.

(Signed)....................

(Title)....................

(Date)....................

New Form for Reporting Conditions of Locomotives

4. Any railroad will accept its own equipment empty at any junction point.

5. Any cars already placed on storage tracks because of surplus will not be moved so long as relocation orders placed as provided in paragraphs numbered 2 and 3 can be filled from other available supply; or as may be specially directed.

6. When roads desire to rebuild their cars, regional directors should make application through the mechanical department of the Railroad Administration, and upon its approval the Car Service Section will authorize the owners to call upon holding roads (as determined from car records) for the return of the cars in such numbers and at such times as their shop operations require. These cars are to be moved on billing stating the authority and that they must not be diverted.

7. In carrying out the policies here indicated caution should be observed by regional directors so as not to bring about burdensome empty car mileage.

The Car Service Section in Circular CS-53 has issued the following instructions: When the terms of Division of Operation Circular 20 or Revisions thereof, movement of freight equipment to the home road is requested by proper mechanical department officer such equipment shall be promptly billed and moved to owners via direct routes. The full routing, including junctions, must be shown, billing to carry the following notation: "Billed via short route. Authority Division of Operation Circular 20, revised, and Car Service Section Circular CS-53. Not to be diverted." The originating line will be held responsible for proper short routing via Federal controlled roads.

STANDARD LOCOMOTIVES DELIVERED TO FEBRUARY 22, 1919

Alabama & W. Point & Western Ry. of Ala.	2		0-8-0	American
Atlantic Coast Line	5		0-6-0	American
Baltimore & Ohio	96	Light	2-8-2	Baldwin
Belt Railway of Chicago	5	Light	2-10-2	American
Boston & Albany	10	Light	2-10-2	American
Central of New Jersey	10		0-6-0	American
	10	Heavy	2-8-2	American
Chesapeake & Ohio	15		2-6-6-2	American
Chicago & Alton	10	Light	2-8-2	American
Chicago Junction	14		0-6-0	American
Chicago & Eastern Illinois	15	Light	2-8-2	American
	5	Heavy	2-10-2	American
Chicago, Burlington & Quincy	10	Heavy	2-10-2	American
Chicago Great Western	10	Light	2-8-2	Baldwin
	2		0-6-0	American
Chicago, Indianapolis & Louisville	5	Light	2-8-2	American
Chicago, Milwaukee & St. Paul	50	Heavy	2-8-2	American
Chicago, Rock Island & Pacific	10		0-6-0	American
Cleveland, Cincinnati, Chicago & St. Louis	25	Light	2-8-2	Baldwin
Duluth, Missabe & Northern	10	Light	2-10-2	American
El Paso & Southwestern	5	Heavy	2-8-2	American
Erie	16		0-8-0	American
	15	Heavy	2-8-2	American
	1	Heavy	2-10-2	American
Grand Trunk Western	16	Light	2-8-2	American
Grand Trunk	24	Light	2-8-2	American
	4		0-6-0	American
Lake Erie & Western	15	Light	2-8-2	Baldwin
Lehigh & Hudson River	4	Light	2-8-2	Baldwin
Louisville & Nashville	20	Heavy	2-8-2	American
	17	Heavy	2-8-2	Lima
Michigan Central	20	Light	2-8-2	American
Mobile & Ohio	10		0-6-0	American
Nashville, Chattanooga & St. Louis	10	Light	2-8-2	American
New York Central	45	Light	2-8-2	Lima
	25		0-8-0	American
	50	Light	2-8-2	American
New York, Chicago & St. Louis	10	Light	2-8-2	American
Oregon Short Line	20	Light	2-8-2	American
	5		0-6-0	American
Pennsylvania Lines West	20		0-6-0	American
Pittsburgh & West Virginia	3	Light	2-8-2	Baldwin
	2		0-6-0	American
Pittsburgh, McKeesport & Youghiogheny	10	Heavy	2-8-2	American
Rutland	2		0-8-0	American
	6	Light	2-8-2	American
Seaboard Air Line	10		0-6-0	American
	10	Light	2-8-2	American
Southern	20		0-8-0	American
	25	Light	2-8-2	American
	50	Light	2-10-2	American
Terminal Railroad of St. Louis	10		0-6-0	American
Texas & Pacific	11	Light	2-8-2	American
Toledo & Ohio Central	5		0-8-0	American
	15	Light	2-8-2	American
Union Pacific	10		0-6-0	American
	20	Light	2-8-2	American
Virginian	5		2-6-6-2	American
Wabash	20	Light	2-8-2	American
Western Pacific	5	Light	2-8-2	Baldwin
Wheeling & Lake Erie	5		0-8-0	American
	10	Heavy	2-8-2	American
Total to February 22, 1919	925			

LOCOMOTIVE AND CAR DELIVERIES IN 1918

According to figures made public by Director General Hines, there were 2,622 locomotives shipped to railroads under federal control during the year ended December 31, 1918. Of this number, 744 were constructed under orders of the Railroad Administration, while 1,410 were contracted for prior to government operation. In the total were 200 Russian decapods, constructed for the Russian government, but never delivered owing to the situation which arose in that country. Of the total number of locomotives delivered during the calendar year 1918, 540 were assigned to the Allegheny region, 375 to the Central Western region, 902 to the Eastern region, 236 to the Northwestern region, 105 to the

Pocahontas region, 361 to the Southern region, and 103 to the Southwestern region.

For the calendar year 1918 there were 700 passenger cars delivered to Class I railroads, while for the same period 40,850 freight cars were delivered. Of the freight cars built during the year 15,230 were U. S. R. A. standard cars. Of the total number of freight cars delivered, 8,683 were built in railroad shops.

LOCOMOTIVE EQUIPMENT CONDITION REPORT

A new form for reporting (weekly) the condition of locomotives has been issued as shown on page 127, to be used commencing with the report for Saturday, March 1.

ORDERS OF THE REGIONAL DIRECTORS

Shop Supervision.—The Eastern regional director quotes from a letter received from W. T. Tyler, director, Division of Operation, dated January 27, as follows:

It is stated that in some of the shops where a change has been made from piecework to hourly or daily basis, the piecework checkers, usually clerks or office men, have been put in the position of foremen at foremen mechanics' rates. I suggest the advisability of cautioning federal managers against leaving any opportunity for criticism in connection with this matter.

Inspection at Interchange Points Covering Loading.—Circular No. 422 issued by the southern regional director says that there has been some duplication of inspection at interchange points covering loading, bracing, stability of packages and general condition of freight offered in interchange. Such inspection and records must be made only by the receiving railroad.

Associations Approved.—The Southern regional director, file 841-6, advises that the director general has approved the Chief Interchange Car Inspectors' and Car Foremen's Association. Similar orders have been issued by the Southwestern and Northwestern regional directors.

General Foremen's Association.—The Northwestern regional director, file 61-1-20, advises that employees who are members of this association be allowed to attend the annual convention, which will be held in the fall of 1919, where they can do so without detriment to the service; transportation should be furnished and necessary expenses allowed.

THE VALUE OF INSULATION AND LOSSES IN B. T. U.'S

BY WILLIAM N. ALLMAN

The question of fuel conservation is one that is now being urged very forcibly upon power plant engineers and operators, and it is quite surprising to note what a large portion of the energy may be saved and converted into useful work by the proper use of insulation.

By the term insulation is meant the proper protection of heated surfaces to prevent the loss of heat, which is measured in terms of British thermal units, and which losses are often underestimated. We have often noted that great care is exercised in guarding against losses in electrical distribution and water leakage and against undue loss in steam pressure between the source of power and the prime movers, yet little or no attention is given to the proper insulation to guard against B. t. u. losses, which are now acknowledged as a vital factor in power plant operation, and so much so that engineers everywhere are now very much engaged in studying these conditions and locating those places where losses may be reduced with a consequent saving in the coal pile.

Steam piping running from boilers to engines and auxiliaries, and hot water lines from heaters and feed pumps, make up a big area of heat radiating surface and so offer opportunities to effect immense savings.

It has been estimated that the loss of heat from bare or poorly insulated pipes represents a loss in fuel ranging from 25 to 75 per cent, and for the reason that this is invisible it can hardly be realized. On the other hand, if it were in the form of a liquid and were visible, steps would be quickly taken to prevent such a loss. Although the eye cannot detect the escape of heat, scientific tests show that a tremendous waste occurs through radiation and poorly insulated pipes.

A large percentage of heat that would be lost if pipes and other apparatus were left bare can be saved by applying the right kind of insulation and thereby preventing unnecessary loss of heat by radiation. It is of importance to select insulation adapted to the service involved to obtain the maximum efficiency, and it is therefore necessary that the proper thickness of insulation be installed. The loss by radiation varies with the difference between the temperature of the steam and the surrounding air and upon the conductivity of the pipe and its covering and upon the extent of the exposed area. An insulation that would allow no heat to escape through it would, of course, be rated as 100 per cent efficient, but this condition does not exist. The efficiency of an insulating material is expressed in terms of percentage, which is the per cent saving realized by insulating a heated surface over what would be lost if the conductor were left bare or uninsulated.

The rate of flow of heat through a certain thickness of material and at a certain difference in temperature determines the conductivity of the material. The relative efficiencies of insulating materials are obtained by comparing their conductivities under similar conditions.

Heat is also frequently wasted where sections of insulation are not closely joined, either on a length of piping, or at its connections with fittings or specialties. All joints or seams in pipe insulation should be carefully sealed. This is especially true where use is made of insulation of a cellular type, allowing circulation of air through longitudinal cells parallel to the pipe.

Different methods of conveying heat and power from one building to another have been developed with widely different resulting efficiencies and costs. One method of distribution has been to surround underground pipes with some form of insulation that rapidly depreciates after installation. Another construction is the tunnel method, with pipes properly insulated, which is efficient but extremely expensive. Again, pipes are very often run overhead out of doors, the insulation being protected by some form of weatherproof jacket. This method is inconvenient as well as not presenting a very neat appearance, and unless very thick insulation of high insulating value is used the results are not what they should be. The underground system with the lines out of sight as well as out of the way and where they cannot interfere with traffic and plant operation should be the most acceptable, provided that the cost compares favorably with other systems and that its insulating value will not depreciate very rapidly.

Table I shows the amount of heat, in B. t. u.'s, lost where pipes are uncovered. It will be seen that a considerable loss of fuel will be occasioned in the course of a year with uncovered pipes, which could be considerably reduced by proper insulation.

There are numerous places in the power plant where savings may be effected by proper and judicious use of insulating materials and elimination of leaks. Items that should receive special attention are leaky baffle walls in boiler settings, infiltration of air through the furnace walls, bare steam pipes, boilers, cylinders, etc. Unless baffle walls are made tight there will be a loss of heat, as the heat which should be passing over the heating surface of the boiler will be short-circuited to the chimney. Cracks in boiler walls may not be very apparent, yet the admission of air through them is more than enough to lower the efficiency of the boiler. This air leakage may easily be detected with a sheet of paper, say, two feet square, having a small hole in the center of it about one inch in diameter, glued to a square wooden frame made of about one-inch stock. Place the frame over the wall and seal the edges all around, then hold a candle or torch in front of the hole. If there are leaks in the setting the flame will be drawn towards the hole in the paper. This matter of air leakage is extremely important, and yet very easy to correct. The application of proper insulation not only prevents the infiltration of air, but reduces the loss of heat from the boiler walls as well. It should be borne in mind that cold air that leaks in through the walls absorbs heat until it reaches the temperature of the furnace gases, and hence wastes heat that would otherwise perform useful work.

TABLE I—TOTAL HEAT LOSS IN B.T.U.'S PER HOUR PER LINEAL FOOT OF BARE PIPE OF DIFFERENT SIZES AND AT VARIOUS TEMPERATURES

Size of pipe in in.	Area (in sq. ft.) of pipe surface per lin. ft.	Temperature Differences (Degrees "F")									
		50	100	150	200	250	300	350	400	450	500
½	.220	21.5	47.3	79.2	117.3	162.3	215.2	279.1	355.1	451.4	569.8
¾	.274	26.8	59.0	98.6	146.8	202.1	268.5	347.6	442.2	562.2	709.7
1	.344	33.6	74.0	123.8	183.4	253.7	337.4	436.5	555.2	705.4	891.0
1¼	.435	42.5	93.6	156.6	231.9	320.8	425.4	551.9	702.1	892.6	1,126.7
1½	.498	48.7	107.2	179.3	265.4	367.3	487.0	631.8	803.8	1,021.9	1,289.8
2	.622	60.9	133.9	223.9	331.5	458.7	608 3	789.2	1,003.9	1,276.3	1,611.0
2½	.751	73.4	161.6	270.4	400.3	553.9	734.5	952.8	1,212.1	1,541.1	1,945.1
3	.917	89.6	197.3	330.1	488.8	676.3	896.8	1,163.4	1,480.0	1,881.7	2,375.0
3½	1.047	102.3	225.3	376.9	558.1	772.2	1,024.0	1,328.4	1,689.9	2,148.4	2,711.7
4	1.178	115.1	253.5	424.2	627.9	868.8	1,152.1	1,494.6	1,901.3	2,417.3	3,051.0
4½	1.308	127.9	281.5	470.9	697.2	964.7	1,279.2	1.659.5	2,111.1	2,684.0	3,387.7
5	1.455	142.2	313.1	523.8	775.5	1,073.0	1,423.0	1,846.0	2,348.4	2,985.7	3,768.5
6	1.733	169.4	371.9	623.9	923.7	1,278.1	1,694 9	2,198.7	2,797.1	3,556.2	4,488.5
8	2.257	220.6	485.7	812.5	1,203.0	1,664.5	2,267.3	2,863.6	3,642.8	4,631.4	5,845.6
10	2.817	275.4	606.2	1,014.1	1,501.5	2,077.5	2,755.0	3,574.1	4,546.6	5,780.5	7,296.0

More horsepower from the coal pile is the one big problem that confronts all power plant engineers. As an illustration of what and where losses may occur in the average power plant, Table II, extracted from Joseph W. Hays' treatise on "How to Build up Furnace Efficiency," is shown. A large amount of heat is shown under the head of preventable losses which may be converted into useful work.

TABLE II—FUEL WASTES BETWEEN THE MINE AND THE MACHINE

	Direct Fuel Wastes	Preventable losses, B.t.u.	Non-Preventable losses, B.t.u.
1.	By weather waste between mine and factory..	....	290,000
2.	In bandling at tbe plant	290,000	....
3.	In the ash (non-preventable)	....	284,200
4.	In tbe ash (preventable)	1,136,800	....
5.	By radiation (non-preventable)	....	284,200
6.	By radiation (preventable)	852,600	....
7.	By incomplete combustion	204,908	....
8.	In chimney to maintain draft	....	3,410,400
9.	On account of air leakage in furnace and boiler setting	2,842,000	....
10.	On account of excess air drawn through grates	2,842,000	....
11.	Due to heating moisture in air and coal.....	....	426,300
	Totals	8,168,308	4,695,100
	INDIRECT FUEL WASTES—HEAT ENERGY LOSSES		
12.	Due to short circuiting of gases in passages of boiler	322,732	....
13.	Due to soot on heating surfaces	1,126,561	....
14.	Due to scale in boiler	1,452,293	....
15.	Due to incorrect correlation of load to draft	1,116,800	....
16.	Due to inability of boiler to reduce temperature of gases below that of the steam in boiler	....	1,280,907
17.	Due to leakage of water and steam	216,685	....
18.	Due to friction and radiation in steam pipes (non-preventable)	....	216,685
19.	Due to friction and radiation in steam pipes (preventable)	866,742	....
20.	With engine exhaust	....	7,627,331
21.	Due to cylinder condensation and radiation..	715,063	....
22.	In friction at engine (non-preventable)	....	119,177
23.	In friction at engine (preventable)	59,588	....
24.	In transmission from engine to machine (non-preventable)	....	231,000
25.	In transmission from engine to machine (preventable)	231,000	....
	Totals	6,107,464	9,475,100
	Grand totals	14,275,772	14,170,200
	Totals of all losses preventable and non-preventable		28,445,972 B.t.u.
	Delivered to the machine		554,028 B.t.u.
	Received from mine		29,000,000 B.t.u.

Note—One ton of coal at the mine is assumed to contain 29,000,000 B.t.u.'s. The items show where the losses occur and their relative magnitude in the average boiler and engine practice.

Now let us ask the question: In the face of all the facts and the serious questions that now affront us, why is fuel wasted, especially when it is one of the most vital factors of the present day in power plant operation? Why is it that the operators are not more persistent in their efforts to locate where the losses occur and then seek a means of reducing them and of putting their plant on a high efficiency basis? We all have heard and no doubt are familiar with the term "passing the buck," and the writer is of the opinion that if this were eliminated from the fireman up to the manager and if everyone would bear in mind that fuel is now the most costly thing they have to deal with, then and then only will the maximum efficiency be realized.

The selection of the proper insulating material with due reference to its insulating efficiency and durability should follow a careful analysis of the conditions and requirements of the case in question. The greatest savings, of course, are to be had by properly insulating the high pressure and high temperature steam lines. Inspect the equipment and ascertain all of the uninsulated surfaces such as steam chests, cylinder heads and all other hot surfaces, which in the aggregate result in high heat losses.

Table III shows what losses may be expected in uninsulated surfaces.

TABLE III—HEAT LOSSES FROM UNINSULATED HOT SURFACES

Temperature of Surrounding Air 70 Deg. F.

Steam pressure (gage)	Steam temperature (deg. F.)	Difference between temperature of steam and surrounding air (deg. F.)	Loss per sq. ft. per hour (B.t.u.)	Waste of of coal in lb. per sq. ft. per year	Number of sq. ft. of surface that wastes a ton of coal in one year
0	212	142	334.0	293	6.82
10	240	170	425.0	372	5.38
25	267	197	522.5	458	4.37
50	298	228	644.0	564	3.55
75	320	250	737.5	646	3.10
100	338	268	820.0	718	2.79
150	366	296	960.0	840	2.38
200	388	318	1,079.0	945	2.12
250	406	336	1,184.0	1,036	1.93

Above figures based on 10,000 B.t.u.'s available per pound of coal, or equivalent to a boiler efficiency of 70 per cent, using coal with an assumed heat value of about 14,000 B.t.u.'s per pound.

The figures are conservative, as both the boiler efficiency and the heat value of the coal are high and a lesser boiler efficiency or inferior grade of coal would cause even a greater waste in pounds of coal.

The loss of steam through open petcocks of steam traps or through leaky traps is extremely large. Leakage is generally due to parts of the trap binding or sticking, worn valve or seats, improper adjustments, defective or worn-out expanding members, etc. It is important that traps and their parts should be frequently and carefully inspected. Steam traps with large surfaces are very often left uninsulated, which results in a considerable loss due to radiation. This loss may be prevented by the application of suitable insulation.

Fuel Conservation Circular No. 14, recently issued by the United States Railroad Administration, is right to the point and the 34 suggestions under the heads of Plant Design and

Equipment, Maintenance and Operation, should be read very carefully by all concerned in the operation of power plants.

The United States Fuel Administration is making every effort to bring home to fuel users the gravity of the situation and the importance of coal and power economy. Only by the whole-hearted co-operation of all power plants, large and small, can the desired savings be effected.

In general, encourage those who work in boiler plants, engine rooms, factories, etc., to be continually on the lookout for heat and fuel losses. Such losses are not difficult to detect. Steam waste can readily be seen and heat felt. If those who discovered steam leaks or loss of heat would take the time and trouble to see whether or not it can be conserved, and then look for the remedy, not only would the nation's fuel be conserved, but the efficiencies of plants and the profits of owners would be increased.

A Unified Mechanical Department*

Suggestions for Co-ordinating the Efforts of Shop, Operating and Mechanical Engineering Branches

BY W. U. APPLETON
Superintendent Motive Power, Canadian Government Railways, Moncton, N. B.

A SYSTEM for regulating and combining the various branches of the mechanical department into one organization that will produce satisfactory service in the general repair shop and the operating branch, obviously, must be broad and definite in its principles. Harmony between the various officers is essential and the relationship between the branches must be very intimate. Success cannot be obtained if the general repair shop and the operating departments are not closely allied; if the shop superintendent is working with the one object of output and the operating officers are not making every effort to obtain the greatest mileage from the locomotives consistent with good service and economy, failure is sure to result.

In order to get results, it is necessary that we should have that co-operation whereby the shop superintendent and all his subordinate officers are giving the same attention to proper repairs as to output, and it should be the object and pride of every master mechanic and his subordinate officers to obtain the greatest mileage between shoppings with the least number of failures.

To repair a locomotive quickly, cheaply and properly, should be the ambition of the shop superintendent.

To maintain it in service with a minimum expense and the greatest number of miles between failures and shoppings, should be the aim and object of the master mechanic.

When locomotives are sent to the shop there should be some system of defining the class of repairs required, and the writer believes that three classes as described below is the best method and sufficient to take care of all repairs:

No. 1—General repairs, including a new firebox, a new cylinder or other such extra heavy repairs.

No. 2—Ordinary general repairs.

No. 3—Specific repairs that may be carried out at the roundhouse or shop.

Abbreviations as follows should be used in conjunction with the numbers to describe specific repairs:

No. 1 Repair	Convers.	means conversion to superheater, etc.
	Boil.	means new boiler.
	F. B.	means firebox.
	Cyl.	means cylinder one or two.
	Fra.	means frames.
	Int.	means internal examination.
	Ext.	means external.
	Der.	means derailment.
No. 2 Repair	Int.	means internal examination.
	Ext.	means external.
	Der.	means derailment.
	T.	means new tires.
No. 3 Repair	T. T.	means tires turned.
	Fr. W.	means frame welded.
	An. T.	means annual test.
	Int.	means internal examination.
	TU.	means fixing up tubes.
	DB.	means driving boxes.
	Der.	means derailment.

No. 1 or No. 2 repairs should not indicate any difference in the condition of the locomotives when turned out of the shop as far as the Operating Department is concerned, as the distinction is only made for the information and assistance of the shop force in effecting repairs, and either of these repairs should represent a locomotive in first class condition in every respect, and capable of making the standard mileage of its class, according to the physical characteristics of the division on which it is employed and the service it is in.

The condition of all parts of the locomotive should be as nearly balanced as possible in order to obtain the greatest mileage with the least loss of service. It is false economy to turn locomotives out of the shop represented as having received the above classes of repair, with certain parts somewhat worn, because they have been renewed a short time previous to shopping. For instance, it may seem wasteful to renew tubes or some part of the machinery that is apparently still capable of making considerable mileage, but as these parts will become defective and make renewal necessary before those that were brought up to standard of shop practice, the result usually is an engine out of service when badly required, delay in effecting repairs and higher cost of doing so on account of lack of facilities at engine-houses as compared with shops.

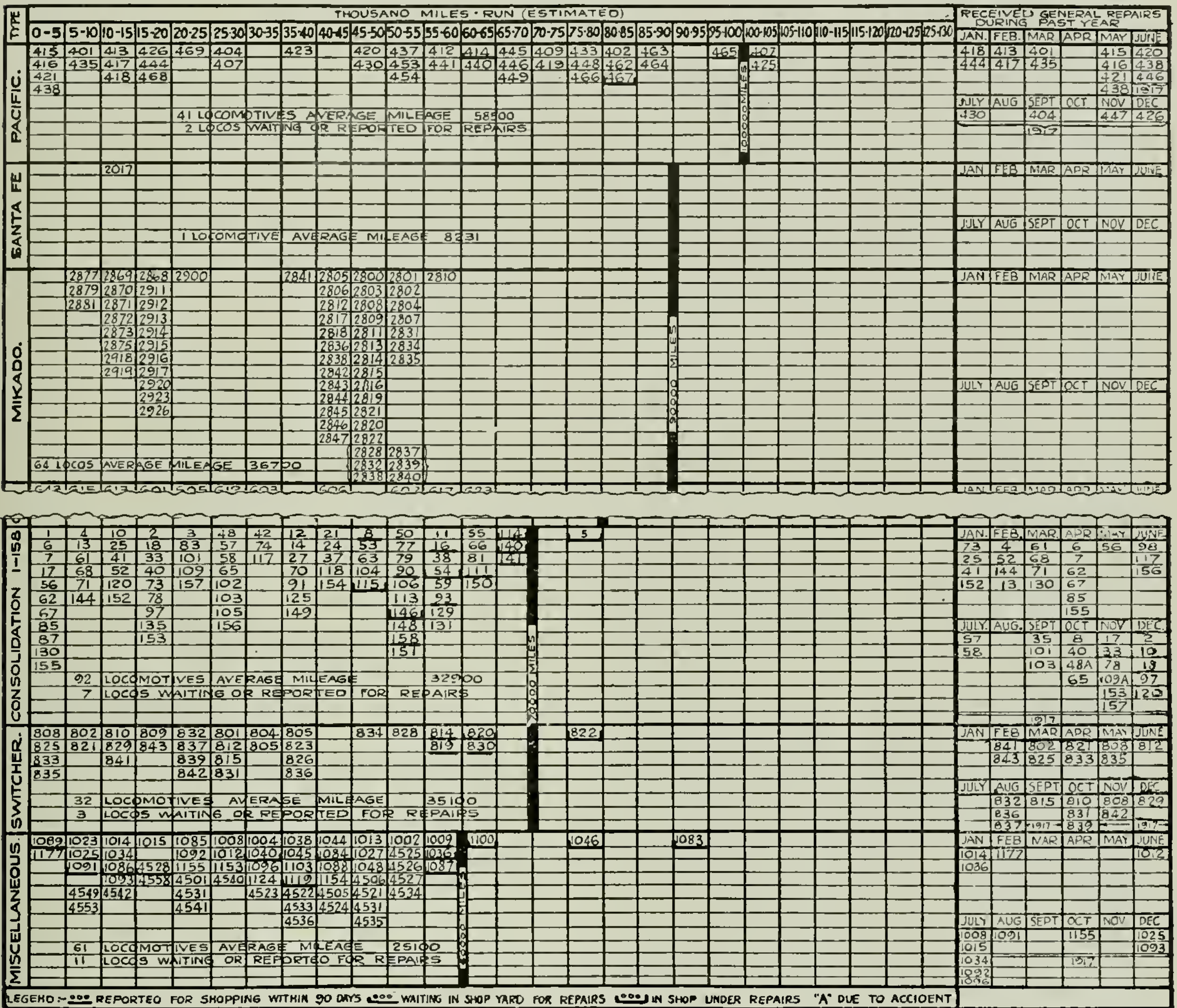
No. 3 repairs differ entirely from those referred to. This class represents specific work and may be done at engine-houses or shops. It is sometimes the result of an accident to or failure of some particular parts, but is generally due to ordinary wear and tear of certain parts of the locomotive that are subject to the most severe service. The parts subject to the greatest wear would not, if the locomotive is properly maintained while in service, represent sufficient work to justify a No. 1 or No. 2 repair, and in order to enable these parts to continue their work until the locomotive is generally worn to the extent necessary to justify a shop repair, it is usually economical to effect such repairs.

The latter class of repairs generally consists of partial renewal of tubes and flues, rod bearing work, lining up wedges, examination of pistons and valves, refitting main driving boxes, removal of lateral play from wheels, and sometimes tire turning. The parts requiring attention will, of course, be found to vary considerably with the different classes of locomotives as well as with the different classes of service they give and the subdivisions on which they are employed. In some classes of locomotives on some subdivisions the tubes and flues will run from shopping to shopping with very little trouble, while others on the same division or the same class on another division will require partial renewal when little more than half the required mileage has been accomplished.

The constant introduction of larger power is so changing conditions as to make the question of doing No. 3 repairs at

* From a paper read before the Canadian Railway Club.

engine-houses one of considerable controversy and the question naturally arises as to the best method of taking care of this work. In the writer's opinion the No. 3 repair should take care of this work except on the smaller and medium classes of power. At engine-houses where there is a heavy fluctuation in traffic it is an advantage to have a No. 3



No. of Locos. Tributary to Moncton Shops.
In roundhouse service 338
In repair shops and yards........ 31

Total 369

Loco. Mileage for April, 1918.
Average Per Loco. in Service, 2392.
11 Locomotives Should Receive General Repairs Proportionate to Above Mileage Excluding Accidents.
11 Locomotives Received General Repairs and 2 Locomotives Received Special Light Repairs During May, 1918.
5 Locomotives Sent in for General Repairs Before Making Standard Mileage:

Loco. No.	Mileage	District
54	55725	4
115	43454	6
146	51821	2
467	80337	3
1040	27992	3

LOCOMOTIVES REPAIRING AND IN SHOP YARDS

Waiting repairs Loco. No.	Date of arrival.	Repairing in shop Loco. No.	Expected out.	
1917				
1083	8-28	5	6-13	1918
1089	11-2	54	8-2	"
1087	8-10	67	6-19	"
1046	9-15	77	6-3	"
1918				
414	5-10	114	6-16	"
615	4-10	115	6-25	"
1036	4-17	140	7-3	"
1084	4-10	146	Waiting	For Cyl.
1086	5-10	284	6-17	1918
1091	1-9	287	6-18	"
1119	4-10	288	6-18	"
4528	4-24	303	6-3	"
M & B No. 3	4-29	308	6-5	"
		407	6-18	"

Total No. of Locomotives Waiting or Reported for Repairs:
Serviceable, 27.
Unserviceable Subject to Instructions, 7.
8 per cent of Serviceable Locomotives Under Repairs and in Shop Yard Waiting.
Locomotives Superheated During Month: No. 438.

Fig. 1—Canadian Government Railways Form Showing Conditions of Locomotives

be continued and not confused with the heavier repairs under classes 1 and 2, this being important in order to determine the condition of the power at all times based on mileage made according to class of repairs, and to avoid expenditures on the power that should not be necessary.

Facilities at engine-houses are generally inadequate to repair gang, as it enables those in charge to hold their staff together and they can be employed to advantage on running repairs when necessary.

In general repair shops where the work is done on schedule and arranged so that the engines will be turned out at regular intervals and No. 3 repairs cannot be taken care of without interfering with the regular work, it is a debatable question as to the advisability of breaking up the organization in order to take care of this work, although under existing conditions there is usually no alternative. The changing conditions will, no doubt, make it necessary to provide certain space in general repair shops for this class of work, where it may be done at lower cost than at engine-houses. Where locomotives have to be hauled or worked a long distance to get to the general repair shop for such repairs, it might be advisable to provide a small shop for this class of repair if the number of engines tributary to it is sufficient.

To enable the shop superintendent to plan his work and maintain his schedule, it is only fair that he should be given all the advice possible as to the class of repair, and a list of the important parts that require replacement at least 30 days in advance of the locomotive coming to the shop. While it may not always be possible to do this on account of engines being damaged in accidents, there is no reason why it cannot be done to a very large extent in ordinary service. A form for reporting the work, shown in Fig. 2, has been found to be very satisfactory.

When making out this report of shop repairs required, master mechanics should devote particular attention to the note advising them to describe any unusual defect.

We all know that when a group of engines is built from the same drawings, even though all the parts are duplicate in every respect, no two of these engines will behave alike in service, but that each individual machine will have its own peculiar virtues and vices. For instance, one engine may jig and ride badly, perhaps the fault is more apparent at certain speeds than at others, and again it may vary with the position of the reverse lever and according to whether the engine is working hard or light. There are several things which might cause this trouble, and unless full particulars are given the real cause may be overlooked, but if the master mechanic will take particular care to describe the defect with all the symptoms he will give the shop superintendent a chance to determine the seat of the trouble.

On taking over an engine from the shop after repairs, the operating department should keep a very sharp lookout for any defect which may be actually present or beginning to develop, and these defects should be completely reported to the shop superintendent within 30 days of the date the engine goes into service. What too often happens is that the operating department will run the engine until there is a failure and then endeavor to throw the whole blame for the failure on the shops, whereas they are really as much to blame as the shops for not reporting the defect earlier.

There are some kinds of defects which often manifest themselves on an engine from the shops, which will disappear after a few days or a few weeks in service, and the operating department often makes the mistake of neglecting to report these defects, as they feel confident that the engine will come round to her work after a week or two in service. Very often their judgment proves correct, but the best policy in cases of this kind is to report the defect immediately, keep a strict watch on it and if no improvement is noticeable within a very short time the defect must be rectified to avoid any chance of engine failure.

The standard maintenance regulations in force on most roads, if faithfully carried out, will prevent a very large percentage of ordinary running failures, but there is a class of failures which cannot be guarded against by any such regulations. I mean failures due to faulty design and poor material. To deal with the failures of this kind is, obviously, the business of the (mechanical) engineering department, and their first and greatest effort should be to locate the prime cause of the failure. Very often the actual part which fails is not the part which is at fault, and if we go ahead blindly and strengthen this part, the evil will not only break out in another place, but very likely with worse results. The maxim of the engineering department should be first to find the root of the trouble and then rectify it.

To determine the mileage that should be obtained from the different classes of locomotives, considerable study and investigation is required, and, in the writer's opinion, a minimum mileage requirement should be established for all sub-divisions for the various classes of locomotives according to service, after receiving a No. 1 or No. 2 repair. If this is not done there is every possibility of locomotives being shopped for expensive repairs before actually required, while others, overdue for shopping on a basis of work done, remain in service, a source of trouble and expense to everybody. We make tests and establish standards as to tonnage that locomotives of the same class shall haul and they are not arbitrary for all divisions irrespective of grades and curves; then why require a locomotive to make as much mileage with the same repairs in way-freight service on a heavy division as in through service on a light division?

CANADIAN GOVERNMENT RAILWAYS

REPORT OF SHOP REPAIRS REQUIRED

Station .... Date ....

Mr. .... Ry.
General Master Mechanic.

Locomotive No.........requires the following repairs and should be shopped within ....days

Estimated class of repairs.................................(See Main Card BB M. B2.)

Give general description of repairs required and describe any special or unusual defect, particularly defective counterbalance, cracked cylinders and those defects which are difficult to discover when engine is in shop.
If No. 3 repair, describe fully what work is required to be completed in the shops.

STANDARD MILEAGE BETWEEN REPAIRS, EITHER NO. 1 OR NO. 2

Pacific	100,000	Ten wheel	90,000
Consolidation, C1 Class	70,000	Switching	50,000 to 60,000, or 2 years' service
Consolidation, C2, 3 & 4 Classes	80,000		

Miles made since last No. 1 or No. 2 repair .... Mileage less or more than standard..........%

Class of Service.................................. To be repaired at ....

Estimated cost of repairs Labor.................. Material..................Total..................

Last No. 1 or No. 2 repair ....Place..................Class of repair..............

Cost. Labor........ Material..................Total................Per mile............

Date of last No. 3 repair ....Date of last Flexible Staybolt Examination ....

Date of last internal examination .... Date of last annual test ....

Date of last external examination..........................

Engineman .... Checked and signed, Foreman..................................

General Boiler Inspector.....................Master Mechanic..................................

Shopping Approved: Cost and Mileage Clerk ....

.... General Master Mechanic .... Supt. Rolling Stock

Date ....

Actual cost of above repairs:

Labor.......... Material.................. Total..................Per Mile..................

Fig 2—Form for Reporting to Shops Advance Information Concerning Repairs Required by Each Locomotive Shopped

Locomotives in assigned service will, I am satisfied, make more mileage at less cost than those in the pool, and in a given time—say 18 months—the assigned engine will possibly make the greater mileage, due to its receiving more care and attention which will keep it in continuous service; but in a rush of traffic for a short period the pooled engine will make the greater mileage. Where traffic is fairly steady I believe that the assigned system is the best, but where heavy fluctuations in traffic have to be met, it might entail too great a capital outlay. I have known a locomotive in assigned service, when the engineer was taking an interest in his work, to make 55 per cent more mileage than a locomotive of the same class in the same service and on the same division, in the pool.

The movement of power from one division to another should be done only under the advice of the motive power department, because otherwise it would possibly result in some roundhouses having a high percentage of power over the shopping period and others with a similar proportion of power just out of the shop.

In order that we may have a comprehensive idea of the condition of our power at all times, the monthly statement illustrated in Fig. 1 has proved to be of considerable value. The form is self-explanatory and it is easy to get an idea of the condition of any particular locomotive, of the general condition of a particular class of locomotive, of the number of locomotives due for shopping, etc.

It will be noticed that in the mileage established for different classes of locomotives there is no provision made for the class of service in which the locomotive is engaged, and it is therefore necessary sometimes to reduce the mileage required for locomotives working under severe conditions, such as way-freight service on a heavy division. It is a difficult and unsatisfactory matter to make rigid laws in such cases and the rules are necessarily slightly elastic.

To sum up, co-operation between the various branches of the mechanical department depends very much more on the men than on the system, and if the heads of the different departments all pull together with the idea of attaining greater efficiency and their subordinates back them up, it will not be difficult to get results.

The operating department should be very careful and very complete with their reports of repairs required when sending locomotives to the shop and should promptly report any defects in engines turned out of the shop.

The shops department should work conscientiously with the idea of making all locomotives good for their full mileage, and should pay special attention to any peculiar or unusual defects reported by the operating department.

The (mechanical) engineering department should be ready at all times with advice and assistance to the shops and operating departments, and when investigating any defects should spare no pains to get right at the root of the trouble before attempting to eliminate it.

Steam vs. Electric Locomotives*

Intelligent Comparison of the Two Types Requires a Knowledge of the Characteristics of Each

The tractive effort of the simple locomotive can be easily calculated from the following formula:

$$TE = \frac{0.85 \, P \times C^2 \times S}{D}$$

where TE = rated tractive effort at rim of driving wheel in pounds.
P = boiler pressure in pounds per sq. inch.
C = diameter of cylinder in inches.
S = stroke in inches.
D = driving wheel diameter in inches.

The maximum tractive effect in general corresponds to about 22 per cent adhesion between the drivers and the rail. Loads on the locomotive must be of such a maximum value that there is a small percentage of tractive effort available for possible starting under maximum grade and load conditions. The locomotive must be rated in terms of maximum load in tons for the division over which it operates, and this maximum tonnage must be corrected for temperature during the winter months. This rating is mentioned because it corresponds somewhat to the continuous rating of the electric locomotive, which we will take up and discuss further on in this article.

The torque of the motor is the pull which it can exert at one foot radius from the center of the armature shaft, i. e., at any point in a circumference of a circle 24 in. in diameter. The formula for the electric locomotive is:

$$TE = \frac{T \times 24 \times G \times \text{gear efficiency} \times N}{D \times g}$$

Where TE = tractive effort
T = torque of motor
G = number of teeth in gear
g = number of teeth in pinion
D = diameter of driver in inches
N = number of motors

The above formula is a general one and considers gearing as the mechanical connection between the motors and the drivers. So as to provide a ready means of enabling the railroad man to calculate the tractive effort and to know the performance of the electric locomotive under consideration, a set of curves are drawn, known as the characteristic curves. These curves show the relation between the current taken by the motor, the torque development and the revolutions. This data is then used to make up a set of curves for the complete locomotive, so that it is possible to read off the total current taken by the locomotive, the pounds tractive effort and the corresponding speed. The tractive effort is obtained by the formula given, and the miles per hour equals

$$\text{r. p. m.} \times D \times \frac{g}{G} \div 336$$

It is apparent that the tractive effort depends on the amount of current which passes through the motors, this current value being at the control of the engineer. There is a practically unlimited supply of power available at the power house compared to that developed by one steam locomotive, and the maximum power the electric locomotive is capable of developing does not depend on a fixed condition as in the case of the boiler of the steam locomotive. It is possible, therefore, to take advantage of extra adhesion with the electric locomotive. This extra adhesion may be natural or caused by the application of sand, and a value as high as 35 per cent has been obtained.

It is not possible to maintain this high maximum tractive effort continuously, which the steam locomotive is capable of doing, on account of resultant damage to the motors, but there is a tractive effort which can be maintained continuously by the locomotive. This leads up to what is meant by the continuous and hourly rating of an electric locomotive.

The tonnage rating of the steam locomotive corresponds, as nearly as the two entirely different machines can be compared, to the continuous rating of the electric locomotive. The continuous rating is fixed, but in a different way from the tonnage rating. The tonnage rating means that this is the maximum load it is safe to haul if the train is to be gotten over the road—allowance being made for a reduction in tractive effort due to poor coal and other factors.

With the electric locomotive, it does not mean that if the continuous rating is exceeded the locomotive will not be able to take the train over the road. It will pull the train and do it on schedule, but it may be at the expense of overheating the motors, and the question of whether damage will result depends on the time the overload is maintained. In addition to the continuous rating, there is the hourly rating which is higher than the continuous rating. Starting with the engine cold, the hourly rating represents the tractive effort which the locomotive could exert for one hour without overheating the motors. The hourly rating is a rating which

*Abstract of an article by A. J. Manson, Westinghouse Electric & Mfg. Co., appearing in the February number of the Railway Electrical Engineer.

does not exist in the steam locomotive. In the latter, the tractive effort depends entirely on the mean effective pressure in the cylinders, while in the former it depends on the amount of current passing through the motors. The current flowing through the motors causes the fields and armatures to heat, on account of the resistance of the conductors. This heat is conducted away by the iron and by radiation, and the whole motor becomes heated. A certain constant current flowing through the motor continuously, will result in a certain temperature rise above the surrounding air, the extent of this depending on the value of the current.

While the electric insulation used in the motor will not be injured if an occasional temperature of 100 deg. C. is reached in service, the ratings of the motors are for a much lower temperature rise—namely, from 60 to 70 deg. C. by thermometer. A continuous current which will give 60 deg. C. rise in temperature is the continuous current rating, and the tractive effort corresponding to this continuous current rating is the continuous tractive effort rating of the locomotive. The hourly rating would be the higher current (and the tractive effort corresponding), which in one hour would give the 60 deg. C. rise. Likewise there can be an indefinite number of ratings for any particular time from say 5 to 10 minutes up to the continuous time. It is the practice, however, to give only the continuous and hourly rating. A very much larger current can be taken for a shorter time without exceeding the allowable temperature rise, and so it is possible to rate the locomotive at a much larger tractive effort for a short time performance.

The tonnage rating of the steam locomotive is the rating for a particular division (varying with different service con-

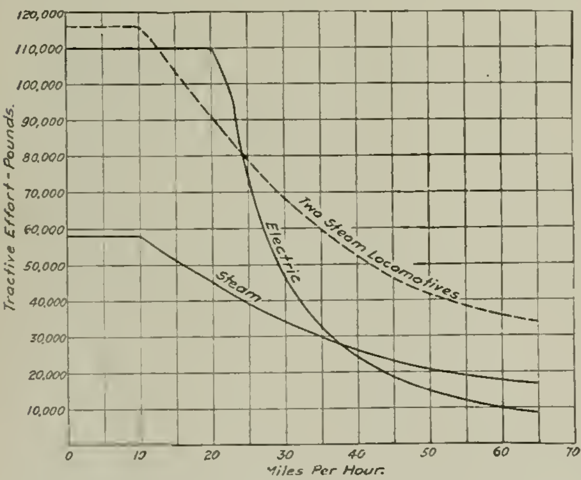


Fig. 1—Relative Tractive Effort of Steam and Electric Locomotives of the Same Weight Operating at Various Speeds

ditions) and is governed by the maximum grade, or by the pull which will be required of the locomotive. The load will be governed by this maximum condition. In the case of the electric locomotive, high tractive efforts can be exerted for short periods of time so that the loading does not depend upon the maximum grade encountered, but upon the whole profile. The load will be governed by what the temperature of the motors will be at the end of the run—not by what the maximum pull may be for 5 or 10 minutes. Therefore, it becomes possible to give the electric locomotive a higher tonnage rating for the same weight upon the drivers than would be possible with the steam locomotive.

There is one more very important point which should be thoroughly understood and appreciated, when considering the electric locomotive, and that is the "horsepower" rating. Horsepower is the product of the tractive effort and the speed. It is a direct measure of the locomotive's capacity to do work. Tractive effort tells how much trailing load can be handled, but it is the horsepower that measures the hourly ton-miles. Electric locomotives excel steam locomotives in this regard. They have the ability to carry the maximum tractive effort to speeds, two or more times that of the steam locomotives.

To better understand what has been covered in the foregoing discussion, an actual comparison has been made of the tractive effort and the horsepower of a steam and an electric locomotive of equal weights, both designed for heavy passenger service over mountain grades. The data of weights, etc., is given in the table. The steam locomotive is of the very latest design, embodying arch tubes and super-

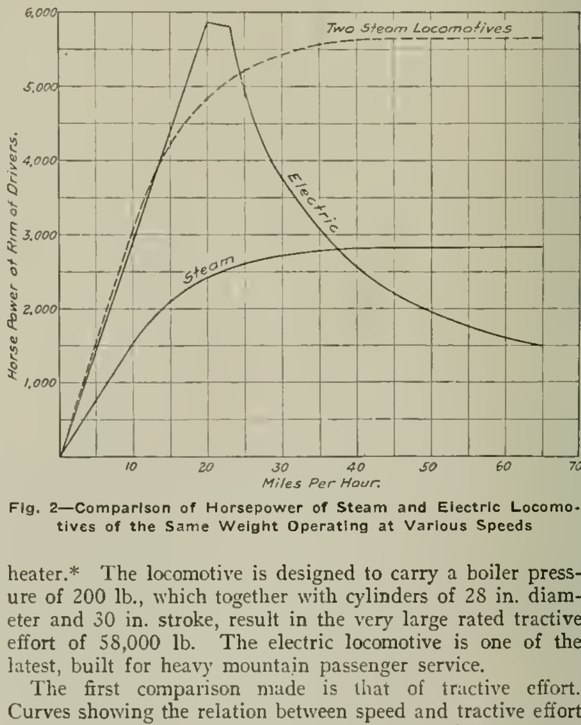


Fig. 2—Comparison of Horsepower of Steam and Electric Locomotives of the Same Weight Operating at Various Speeds

heater.* The locomotive is designed to carry a boiler pressure of 200 lb., which together with cylinders of 28 in. diameter and 30 in. stroke, result in the very large rated tractive effort of 58,000 lb. The electric locomotive is one of the latest, built for heavy mountain passenger service.

The first comparison made is that of tractive effort. Curves showing the relation between speed and tractive effort for the two types are shown in Fig. 1. The maximum tractive effort of the steam locomotive is 58,000 lb., while that of the electric is 110,000 lb. Reference to the data in the table shows that the weight on the drivers is 330,000 lb., so that the 110,000 lb. tractive effort for starting is based on 30 per cent adhesion, a conservative value for the electric locomotive. This maximum tractive effort in the case of the electric locomotive is carried out to a speed of 20 miles per hour, while the steam locomotive cannot maintain its maximum beyond 10 miles per hour. The electric locomotive curve drops rapidly, and at 38 miles an hour both types are the same. To better appreciate what this large tractive effort of the electric locomotive means, a curve has been drawn in, showing what the tractive effort would be for two steam locomotives operating as a double-header. The dotted curve is slightly higher for the maximum tractive effort, but in practical work the one electric could start the same train as the two steam locomotives, and would have an advantage over them up to a speed of 24 miles an hour. When it is considered that on heavy passenger mountain service, speeds do not greatly exceed this figure, it becomes clear that the one electric locomotive is nearly equivalent to the two steam locomotives.

*The U. S. R. A. standard heavy Mountain type.

It must be remembered that the two steam locomotives could maintain this speed continuously with a tractive effort of 80,000 lb., while the electric locomotive could not on account of the electric motors requiring a current much above the continuous rating.

Since horsepower is such an important factor, Fig. 2 has been drawn, showing the relative horsepower for the two engines chosen. Here the comparison is even more striking, and the great advantage of the electric locomotive is easily recognized. This electric locomotive of the same weight as the steam, has a maximum developed hp. rating at the rims of the drivers of 5,860 hp. compared to 2,825 hp. for the steam locomotive. And when compared with two steam locomotives it shows, for the working range, the ability to deliver the equivalent in hp. Of course, the continuous

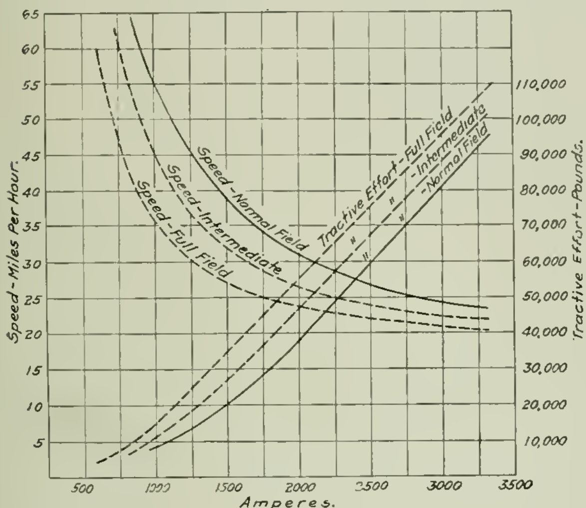


Fig. 3—Characteristic Curves for 266-Ton Electric Locomotive

rating must not be lost sight of, and for the electric locomotive this is 3,200 hp. The increase in horsepower is due to the increased speed for the same tractive effort. Referring to Fig. 1, assume there is a passenger train requiring at certain sections or grades, a tractive effort varying from 50,000 lb. to 40,000 lb. At 50,000 lb., the speed of the steam locomotive would be 16½ miles per hour—the electric, 29 miles per hour—nearly double. At 40,000 lb., the steam locomotive would be 24.5 miles per hour—the electric, 32.

COMPARISON OF STEAM AND ELECTRIC LOCOMOTIVES OF EQUIVALENT WEIGHTS

Characteristics	Steam	Electric
	4-8-2	4-6-2—2-6-4
Weight—engine and 14 ton tender....	268.5 tons	266 tons
Weight—engine only.................	352,000 lb.	532,000 lb.
Weight—engine on drivers......	243,000 lb.	330,000 lb.
Number of pairs of drivers..........	4	6
Weight per pair.....................	60,500 lb.	55,000 lb.
Wheel diameter, inches..............	69	68
Total wheel base engine and tender...	75 ft. 8.5 in.	79 ft. 10 in.
Maximum tractive effort.............	58,000	110,000
Maximum horse power.................	2,825	5,860
Continuous horse power..............	2,825	3,200

Characteristic curves showing the relation between speed, tractive effort and the current taken by the locomotive, are supplied by the electrical manufacturers. The set of curves for the electric locomotive under consideration are shown by Fig. 3. From these curves the tractive effort at any speed can be read off directly. It is noted there are three speed curves and three tractive effort curves corresponding. This locomotive uses "field controls," thus reducing resistance losses. The tractive effort and horsepower curves covered the "normal field condition." To show, briefly, what is gained with this field control, consider the continuous horsepower rating of 3,200 hp. With normal field this corresponds to a speed of 34 miles an hour and a tractive effort of 35,000 lb. If a greater tractive effort is necessary continuously the speed can be reduced by operating on full field when a speed of 24.5 miles per hour is obtained at a tractive effort of 49,000 lb.

ANNUAL REPORT OF THE I. C. C. LOCOMOTIVE INSPECTION BUREAU

The seventh annual report of the chief inspector of locomotive boilers for the fiscal year ended June 30, 1918, covers the work done under the locomotive-boiler inspection act as amended to apply to the entire locomotive and tender and all their parts and appurtenances.

TABLE I—LOCOMOTIVES INSPECTED, NUMBER FOUND DEFECTIVE, AND NUMBER ORDERED OUT OF SERVICE

	1918	1917	1916
Number of locomotives inspected.....	41,611	47,542	52,650
Number found defective..............	22,196	25,909	24,685
Percentage found defective..........	53	54.5	47
Number ordered out of service.......	2,125	3,294	1,943

Table I shows, in concrete form, the number of locomotives inspected, the number and percentage found defective, and the number ordered out of service on account of not

TABLE II—NUMBER OF ACCIDENTS, NUMBER KILLED, AND NUMBER INJURED, BY COMPARISON

	1918	1917
Number of accidents............................	641	616
Increase over previous year..........per cent..	4.1	...
Number killed	46	62
Decrease from previous year........per cent..	25.8	...
Number injured	756	721
Increase over previous year.........per cent..	4.8	...

meeting the requirements of the law. Table II shows the total number of accidents due to failure from any cause of locomotives or tenders and all parts and appurtenances thereof and the number killed and injured thereby.

Table III shows the total number of persons killed and injured by failure of locomotives or tenders, or any part of appurtenance thereof, during the three years ended June 30, 1916-1918, classified according to occupations.

A summary of the accidents and casualties resulting therefrom during the year shows an increase of 4.1 per cent in the number of accidents, with a decrease of 25.8 per cent in the number killed, and an increase of 4.8 per cent in the number injured.

The decrease in the number of locomotives inspected during the year is due to the fact that a substantial percentage of the inspectors of locomotives were engaged in special work during most of the year. During the months of November and December, 1917, almost all of the inspectors were engaged, at the request of the Interstate Commerce Commission, in checking the congestion at terminals in an effort to see that locomotives were promptly furnished so that the coal movement might be facilitated and the fuel shortage relieved; and during the months of January, February, and March, 1918, were performing similar work at the request of the director general of railroads, and this work contributed materially toward breaking the blockade and expediting the movement of coal and other freight. It is also due in part to the fact that a number of inspectors of locomotives were permanently transferred to the service of the director general of railroads because of their general knowledge of equipment and their training in conducting investigations.

The period covered by this report represents what is admitted to have been the most difficult in the history of American railroads to properly maintain locomotives. This is primarily due to the war conditions which made it necessary to use to their maximum capacity all locomotives that were serviceable, and to return to service many locomotives that had been out of service for years awaiting disposition and which, in some cases, were put in service without having been thoroughly repaired. Proper maintenance of locomotives was also made difficult by the large number of mechanics that entered military service. The excessive demands for power resulted in the use of many locomotives that were in violation of federal laws, but the results of this practice were clearly demonstrated during the past winter.

These conditions rendered the work of the inspectors exceedingly difficult, and considerable pressure from various sources was brought to bear on them to prevent the enforcement of the law where locomotives were sorely needed. The shortage of power made it necessary in every case for inspectors to exercise the utmost good judgment and discretion in their work in order to avoid any possibility of causing additional congestion which an inflexible enforcement of the law might have brought about. The fact that the enforcement of the locomotive inspection laws during this trying period did not unnecessarily hamper the movement of traffic, but on the contrary the work of the inspectors, in hundreds of instances, facilitated the operation of locomotives and the movement of trains, is evidence not only of the discretion and judgment of inspectors in their enforcement of the law, but also of the wisdom and farsightedness of its framers, because it is generally admitted that the law and the work of the inspection bureau was of substantial benefit during the past winter, and when we consider, in addition to this, the fact that the general condition of locomotives has improved during the year, due, in part, to the work of the inspectors, the results become particularly creditable.

TABLE III—THREE-YEAR COMPARISON OF CASUALTIES CAUSED BY FAILURE OF LOCOMOTIVES, TENDERS AND APPURTENANCES, CLASSIFIED BY OCCUPATIONS

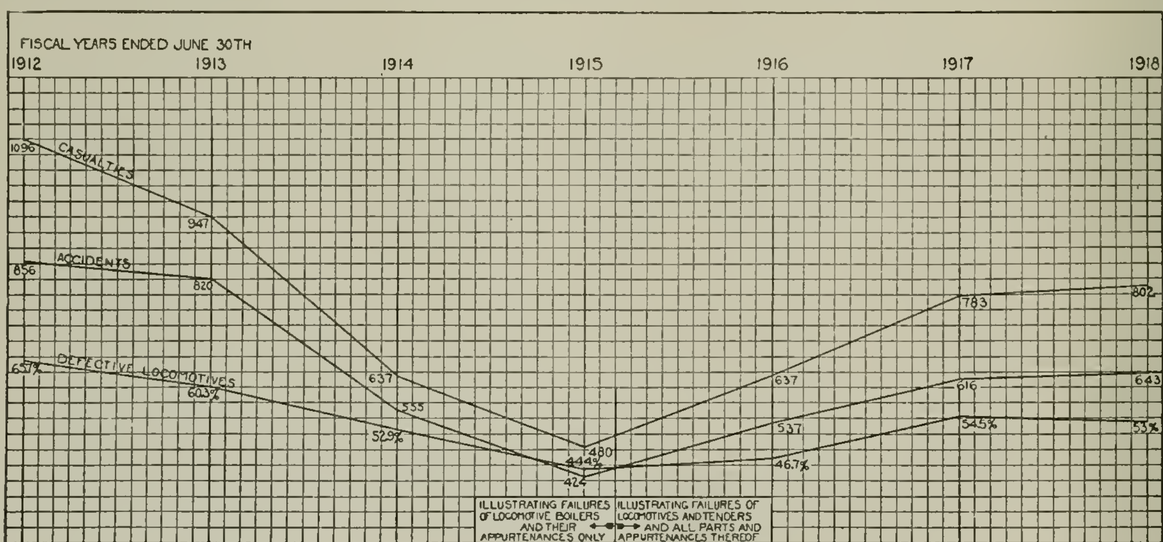
	1918		1917		1916	
	Killed	Injured	Killed	Injured	Killed	Injured
Members of train crews:						
Engineers	11	245	16	230	11	205
Firemen	19	306	21	304	12	225
Brakemen	6	62	13	60	9	74
Conductors	..	21	3	14	1	6
Switchmen	2	8	1	8	..	6
Roundhouse and shop employees:						
Boiler makers	1	11	...	11	1	11
Machinists	..	11	...	8	1	11
Foremen	1	4	...	1	1	3
Inspectors	4	4	...	3	...	3
Watchmen	..	3	...	5	...	8
Boiler washers	..	4	...	7	...	10
Hostlers	..	8	...	6	...	6
Other roundhouse and shop employees	2	19	2	19	1	21
Other employees	..	26	5	22	...	7
Non-employees	..	24	1	23	1	3
Total	46	756	62	721	38	599

During the year 353 applications were filed for extension of time for removal of flues under the provisions of Rule 10. Investigation showed 18 of these locomotives in such condition that no extension could properly be granted. Forty-two were in such condition that the full extension requested could not be granted, but an extension for a shorter period was allowed. Thirteen extensions were granted after defects disclosed by our inspectors had been repaired. Sixty-two applications were withdrawn for various reasons, and the remaining 218 were granted for the full period asked for. It will be noted that the number of applications for extension of time for removal of flues decreased about 50 per cent. This is largely due to the modification of the rule which was recommended to the Commission and approved by it.

As provided in Rule 54, 3,124 specification cards and 8,080 alteration reports were filed.

The locomotive headlight case, which has been pending for approximately three years, was finally disposed of June 7, 1918, by the withdrawal by the complainant and at the complainant's cost, of bill in equity No. 226, United States District Court, District of Indiana, *New York Central Railroad Co. v. United States*, in which it was sought to restrain the Interstate Commerce Commission from enforcing its order. This withdrawal was made after arguments on the bill had been heard by the court and the position of the complainants declared to be unsound.

In the sixth annual report recommendations were made that locomotives should be equipped with automatic fire doors and that a steam connection to air-operated power reverse gear should be applied. It is not considered necessary to repeat these recommendations at this time for the reason that both recommendations have been adopted by the United States Railroad Administration, and all standard United States locomotives are being so equipped, and it is expected that these recommendations will be generally followed on locomotives passing through the shop for general repairs, so far as material and labor are available.



Relation of Defective Locomotives to Accidents and Casualties Resulting from Locomotive Failures.

Standard Equipment Specialties

The Distribution, by Classes of the Special Equipment Used on Government Cars and Locomotives

The specialties applied to the standard cars and locomotives built for the Railroad Administration have been published in the *Railway Mechanical Engineer* from time to time during the year. In order to give a better idea of the distribution of the use of these specialties among the various classes of equipment the accompanying tables have been compiled. A few minor changes were made in the original lists showing the distribution of the orders, primarily on account of delivery.

The companies receiving orders for the specialties for the locomotives are shown in the table under the various specialty items and on which class of power these specialties are used. In case one specialty is used on all locomotives, such as the American Arch Company arch, it is so designated.

The table showing the specialties for the cars includes only those for the cars which have been built thus far, as information is not obtainable as to just which of the specialties will be applied to the other cars.

SPECIALTIES FOR THE STANDARD LOCOMOTIVES

	All locomotives	Mikado		Mountain		Pacific		Santa Fe		Switcher		Mallet	
		Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	0-6-0	0-8-0	2-6-6-2	2-8-8-2
Air Brake—													
Westinghouse Air Brake Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New York Air Brake Co.	...	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arch—													
American Arch Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bell Ringer—													
Harry Vissering & Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Blow-off Cock—													
Everlasting Valve Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Southern Loco. Valve Gear Co.	...	No	Yes	No	No	No	No	Yes	No	No	Yes	No	No
Okadee Co.	..	Yes	No	No	No	No	No	No	Yes	Yes	No	Yes	Yes
Blower Fitting—													
Barco Manufacturing Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bolster—Tender Truck—													
Pittsburgh Steel Foundries	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake—													
American Brake Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake Beams—Tender Truck—													
Chicago Railway Equip. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake Beam Support—													
Chicago Railway Equip. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake Cylinder Expander Ring													
H. W. Johns-Manville Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake Shoes—													
American Brake Shoe & Foundry Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Buffer—Radial—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bumper—Front—													
Commonwealth Steel Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bushings—Cylinder and Valve—													
Hunt-Spiller Mfg. Corp.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cellars—Driving Box—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coal Pusher—													
Locomotive Stoker Co.	...	No	No	No	No	Yes	No	No	No	Yes	Yes	No	No
Coupler—													
National Mall. Cast. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coupler Yoke—													
Buckeye Steel Castings Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crosshead Shoes—													
Hunt-Spiller Mfg. Corp.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Draft Gear—													
Westinghouse Air Brake Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dust Guards—													
W. N. Thornburg Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fire Door—													
Franklin Railway Supply Co.	...	No	Yes	No	No	No	No	Yes	Yes	No	Yes	No	No
National Railway Device Corp.	...	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Frame—Tender—													
Commonwealth Steel Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Frame—Tender Truck Side—													
American Steel Foundries	...	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Buckeye Steel Castings Co.	..	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Gages—Steam—													
Ashcroft Mfg. Co.	..	Yes	Yes	No	Yes	No	No	No	Yes	Yes	No	No	Yes
Ashton Valve Co.	...	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	No
Gages—Steam Heat—													
Ashton Valve Co.	...	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Gages—Water—													
Sargent Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gage Cocks—													
Nathan Mfg. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grate Shaker—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Headlight Case—													
Schroeder Headlight & Gen. Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Handlon & Buck Mfg. Co.	...	Yes	Yes	No	No	No	No	No	No	No	No	Yes	Yes
Adams & Westlake Co.	...	No	No	No	No	No	No	No	No	Yes	No	No	No
Headlight Equipment—													
Pyle National Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schroeder Headlight & Gen. Co.	...	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	No	No
Injectors—													
Nathan Mfg. Co.	..	Yes	Yes	No	No	No	No	No	No	Yes	No	Yes	No
Hancock Inspirator Co.	...	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes
Ohio Injector Co.	...	No	No	No	No	No	No	Yes	No	No	No	No	No
Joints—Metallic Pipe—													
Barco Manufacturing Co.	...	No	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Franklin Railway Supply Co.	...	Yes	No	No	No	No	No	No	No	Yes	Yes	No	No
Greenlaw Mfg. Co.	...	Yes	No	Yes	Yes	No	No	No	No	No	No	No	No
Lubricator—													
Nathan Mfg. Co.	..	Yes	Yes	No	No	No	No	No	No	No	Yes	Yes	Yes
Detroit Lubricator Co.	...	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Lubricator—Driving Box—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Oil Cups—Guide, Piston Rod, Valve Stem—													
Hancock Inspirator Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	All loco-motives	Mikado		Mountain		Pacific		Santa Fe		Switcher		Mallet	
		Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	0-6-0	0-8-0	2-6-6-2	2-8-8-2
Packing—Piston & Valve Rod—													
United States Metallic Pack. Co.	...	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No
Paxton-Mitchell Co.	...	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Packing Rings—Cylinder and Valve—													
Hunt-Spiller Mfg. Corp.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reverse Gear—													
Ragonnet (Frank. Ry. Sup. Co.)	...	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Lewis (Commonwealth Sup. Co.)	...	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Mellin (Am. Loco. Co.)	..	No	No	No	No	No	No	No	No	Yes	No	No	No
Brown (Sou. Loco. Valve Gear Co.)	...	No	No	No	No	No	No	No	No	No	Yes	No	No
Safety Bar (Unit)—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sanders—													
U. S. Metallic Packing Co.	...	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Hanlon Loco. Sander Co.	..	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No	No	No
Harry Vissering & Co.	...	No	No	No	No	Yes	Yes	No	No	No	No	No	No
Side Bearing—Tender—													
E. S. Woods & Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Springs—													
Crucible Steel Co.	...	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Ft. Pitt Spring & Mfg. Co.	...	No	Yes	No	No	No	No	No	Yes	Yes	No	Yes	Yes
Pittsburgh Spring & Steel Co.	...	Yes	No	No	No	Yes	No	No	Yes	No	No	No	No
Railway Steel Spring Co.	...	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No
Standard Steel Works	...	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	No
Union Spring & Mfg. Co.	...	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Sprinkler—													
Wm. Sellers Co., Inc.	...	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No
Hancock Inspirator Co.	...	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stoker—													
Locomotive Stoker Co.	...	Yes	No	No	No	No	Yes	Yes	No	No	No	No	Yes
Standard Stoker Co.	...	No	Yes	Yes	Yes	No	No	No	No	No	No	Yes	No
Hanna Loco Stoker Co.	...	No	No	No	No	No	No	No	Yes	No	No	No	No
Superheater—													
Locomotive Superheater Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Throttle Valve—													
Chambers Valve Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Truck—Trailer—													
Hodges (Baldwin Loco. Works)	...	Yes	No	No	No	No	No	No	No	No	No	No	No
Cole-Scoville (Am. Loco. Co.)	...	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Uncoupling Device—													
Imperial Appliance Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Valves—Blower—													
Sargent Company	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Valve Gear—													
Walschaert	...	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Pilliod Co. (Baker)	...	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Southern Loco. Valve Co.	...	No	No	No	No	No	No	Yes	Yes	No	No	No	No
Valve—Check—													
Nathan Mfg. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Valve—Piston—													
American Balanced Valve Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Valve—Safety—													
Consolidated Safety Valve Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Coale Muffler & Safety Valve Co.	...	No	Yes	No	No	No	No	Yes	No	Yes	No	Yes	No
Ashton Valve Co.	...	No	No	No	No	No	No	No	Yes	No	No	No	Yes
Valve—Steam Heat—													
Vapor Car Heating Co., Inc.	...	No	No	Yes	No	Yes	No	No	No	No	No	No	No
Leslie Co.	...	No	No	No	Yes	No	Yes	No	No	No	No	No	No
Ventilator—Cab—													
Rushton (Bald. Loco. Works)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wheels—Rolled Steel—													
Forged Steel Wheel Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Standard Steel Works	...	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

SPECIALTIES FOR STANDARD CARS THUS FAR BUILT

	D. S. Box	S. S. Box	Comp. Gon.	55-Ton Hopper	L. S. Gon.
Angle Cock Holders—					
Western Railway Equipment Co.	Yes	Yes	Yes	Yes	Yes
Bearing, Journal—					
Magus	Yes	Yes	Yes	Yes	Yes
Keystone	Yes	Yes	Yes	Yes	Yes
Haskel & Barker	Yes	Yes	Yes	Yes	No
Ajax	Yes	Yes	Yes	Yes	Yes
Bostwick & Lyons	Yes	Yes	Yes	Yes	No
Bearings, Lick Frictionless—					
Wine Railway Appliance Co.	Yes	No	Yes	No	No
E. S. Woods & Co.	No	Yes	Yes	No	No
A. Stucki Co.	No	No	Yes	Yes	Yes
Bolsters, Truck—					
American Steel Foundries	Yes	Yes	Yes	Yes	Yes
Buckeye Steel Castings Co.	Yes	Yes	Yes	Yes	Yes
Gould Coupler Co.	Yes	Yes	Yes	Yes	No
Scullin Steel Co.	Yes	Yes	Yes	Yes	No
Bettendorf Co.	No	Yes	Yes	Yes	No
Boxes, Journal—					
National Mall. Cast. Co.	Yes	Yes	Yes	Yes	Yes
Gould Coupler Co.	Yes	Yes	Yes	Yes	Yes
American Mall. Cast. Co.	Yes	Yes	Yes	Yes	No
Union Spring & Mfg. Co.	Yes	Yes	Yes	Yes	Yes
T. H. Symington Co.	Yes	Yes	Yes	Yes	No
Brakes, Air—					
New York Air Brake Co.	Yes	No	No	No	No
Westinghouse Air Brake Co.	No	Yes	Yes	Yes	Yes
Brake Beams, Tender—					
Buffalo Brake Beam Co.	Yes	Yes	No	Yes	No
Davis Brake Beam Co.	Yes	No	Yes	Yes	Yes
American Steel Foundries	Yes	No	Yes	No	No
Joliet Railway Equipment Co.	Yes	Yes	Yes	Yes	No
Damascus Brake Beam Co.	Yes	No	Yes	Yes	No
Haskell & Barker	Yes	Yes	Yes	No	No
Pressed Steel Car Co.	Yes	No	No	Yes	Yes
Chicago Railway Equipment Co.	No	Yes	Yes	Yes	No
Brake Shoes—					
American Brake Shoe & Fdry. Co.	Yes	Yes	Yes	Yes	Yes
Couplers—					
American Steel Foundries	Yes	Yes	Yes	Yes	Yes
Buckeye Steel Casting Co.	Yes	Yes	Yes	Yes	Yes
Gould Coupler Co.	Yes	Yes	Yes	Yes	Yes
McConway & Torley	Yes	Yes	Yes	Yes	Yes
National Mall. Cast. Co.	Yes	Yes	Yes	Yes	Yes

	D. S. Box	S. S. Box	Comp. Gon.	55-Ton Hopper	L. S. Gon.
Davis' 3d Point Suspension—					
Chicago Railway Equipment Co.	Yes	Yes	Yes	Yes	Yes
Door Fixtures (Slide)—					
Camel Company	No	Yes	No	No	No
Draft Gear, Friction—					
Westinghouse Air Brake Co.	Yes	Yes	Yes	Yes	Yes
Standard Coupler Co.	Yes	Yes	Yes	Yes	Yes
Union Draft Gear Co.	Yes	Yes	Yes	Yes	Yes
Keyoke Railway Equipment Co.	Yes	Yes	Yes	Yes	Yes
Dust Guards—					
Wm. N. Thornburgh Co.	Yes	Yes	Yes	Yes	Yes
Ends, Pressed Steel—					
Pressed Steel Mfg. Co.	Yes	Yes	Yes	No	No
Chicago & Cleveland Car Roof Co.	No	No	Yes	No	No
Frames, Truck—					
American Steel Foundries	Yes	Yes	Yes	Yes	Yes
Bettendorf Co.	Yes	Yes	Yes	Yes	No
Buckeye Steel Cast. Co.	Yes	Yes	Yes	Yes	Yes
Gould Coupler Co.	Yes	Yes	Yes	Yes	No
Scullin Steel Co.	Yes	Yes	Yes	Yes	No
Hose, Air Brake—					
New York Air Brake Co.	Yes	No	No	No	No
Westinghouse Air Brake Co.	No	Yes	Yes	Yes	Yes
Uncoupling Device—					
Imperial Appliance Co.	Yes	Yes	Yes	Yes	Yes
Wedges, Journal Box—					
Western Railway Equipment Co.	Yes	Yes	Yes	Yes	Yes
Wheels, Cast Iron—					
Brass Foundry & Machine Co.	Yes	Yes	Yes	Yes	No
Louisville Car Wheel & Supply Co.	Yes	Yes	Yes	No	No
Albany Car Wheel Co.	Yes	Yes	Yes	No	No
Southern Car Wheel Co.	Yes	Yes	Yes	Yes	No
New York Car Wheel Co.	Yes	Yes	Yes	No	No
Ramapo Car Wheel & Foundry Co.	Yes	Yes	Yes	Yes	No
Buffalo Car Wheel & Foundry Co.	Yes	Yes	Yes	Yes	No
Brown Car Wheel Works	Yes	Yes	Yes	No	No
Griffin Car Wheel Works	Yes	Yes	Yes	Yes	Yes
Western Steel Car Co.	Yes	Yes	Yes	No	No
Standard Car Wheel Co.	Yes	Yes	Yes	No	No
National Car Wheel Co.	Yes	Yes	Yes	Yes	No
Wheels, Steel—					
Standard Forged Steel	No	No	No	Yes	Yes
Pressed Steel (Carnegie)	No	No	No	Yes	Yes
Yokes, Draw Bar—					
Buckeye Steel Castings Co.	Yes	Yes	Yes	Yes	Yes
Union Draft Gear Co.	Yes	Yes	Yes	Yes	Yes

LINING AND FLOOR RACKS FOR CARS HANDLING PERISHABLE FREIGHT

The car service section of the Railroad Administration issued Circular CS-43 (revised), dated January 30, covering the use of refrigerator and box cars to be used in the transportation of perishable freight.

Refrigerator Cars.—(1) Railroads will supply refrigerator cars for shipment of fruits and vegetables to the extent of their ability. A certain percentage of this class of cars belonging to the various railroads is already equipped with false floors or floor racks. It is contemplated eventually to equip in this manner all such cars owned by roads under federal control, and also cars of the following refrigerator lines: Pacific Fruit Express Company, Santa Fe Refrigerator Despatch, American Refrigerator Transit Company and the 'Frisco Refrigerator Line.

RETURN TO

....
(Insert name of shipper.)

AT

....
(Name of station.)

.... RAILROAD
(Name.)

UNITED STATES RAILROAD ADMINISTRATION

Instruction Card for Return of Cars

2. It will not be practicable for the railroads to equip a sufficient number of cars to fully meet the requirements of the present season. Therefore, if refrigerator cars owned by federal-controlled roads, or cars belonging to any of the above named refrigerator lines, not equipped with floor racks, are offered for loading fruit and vegetables, shippers, if they so desire, will be privileged to construct and place in cars suitable racks of standard type, in accordance with specifications shown on accompanying print. Racks when so placed will become a permanent part of the car.

3. Railroads will reimburse shippers for the value of floor racks placed as above described at the rate of fifty cents per linear foot of rack. This reimbursement will be made by the road on which load is first placed in car following installation of floor racks.

4. Any *lining* desired by shippers in refrigerators in addition to floor racks must be placed by them at their own expense, and in such manner as not to damage the car or insulation.

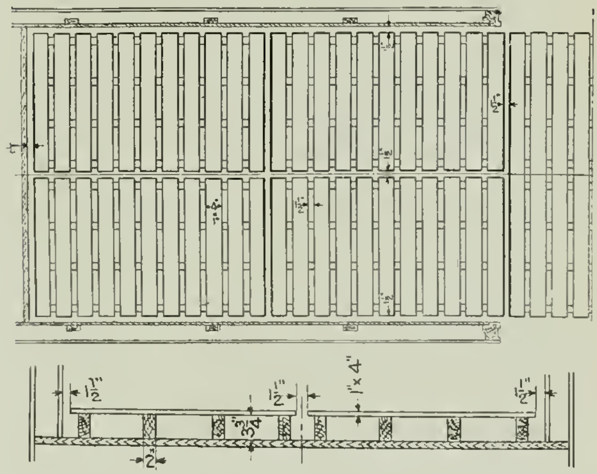
Box Cars.—(5) When railroads are unable to meet the demand for refrigerator cars for above named shipments, if shippers elect to make use of box cars, and if in their opinion such cars require lining, they (the shippers) will be given the privilege of equipping the cars with such lining entirely at their own expense.

6. In the interest of promoting shipments and conserving food supply, it is suggested that the lining of box cars, when done, conform to the following standard furnished by the Bureau of Markets, United States Department of Agriculture, which, it is believed, will give the best results:

"False floors, side and end walls shall be installed providing an unobstructed space for air circulation down between the car and walls and false end walls, and from there under the false floors to the doorways. This ventilating space must be kept clear of hay, straw, manure, shavings, and everything except the necessary false-floor supports. There shall be a space between the car side walls and the false side walls of not less than four inches at the top and six inches at the bottom.

"Each doorway shall be tightly boarded not less than 24 in. from the floor upward, the boards being nailed to the inside of the door frame to keep out cold winds."

7. For the same reason it is further requested that shippers make it a practice to use box cars for the shorter hauls, reserving refrigerator cars for loading to the more distant points. Railroads will supply refrigerator cars preferentially as compared with box cars, for the longer runs.



Arrangement of Floor Racks for Cars Handling Perishable Freight

8. Box cars that may be lined by shippers will be furnished with a board on either side, of uniform dimensions (24 in. by 30 in.), with lettering of suitable size, reading as shown in the illustration.

9. These boards will be furnished by the railroads. Lined box cars so boarded will be returned free, with lining, to point of origin of load, and should be waybilled to such point, consigned to party or firm whose name the board bears. They may be loaded all or a part of the way

on return trip with any suitable freight. They must not be loaded out of direct line, and care should be exercised to avoid damage to lining in loading or unloading.

10. It must be understood that cars thus lined and boarded are subject to demurrage, either while awaiting loading or unloading.

11. The privilege of equipping box cars as above will extend from November 15, 1918, to April 1, 1919. In the event of failure to return lining to shippers within three months from the last named date, roads on which it was originally placed in cars will refund to party furnishing same the sum of twenty-five dollars per car in full payment for the value of the lining, but only when installed in conformity with the specifications named in paragraph 6. In the case of box cars the term "lining" will be understood as including false floor as well as lining of side and end walls.

12. Roads on which cars are equipped should keep an accurate account, showing date, number and initial of car and name of shipper to avoid any misunderstanding in making settlement in case of loss.

13. After April 1, shippers will be required to promptly remove from cars any lining which belongs to them. Failing to remove such equipment, the work of removal will be performed by the railroads, but the latter will not be responsible to owners for the material or its value after removal.

14. Provisions herein contained which relate to reimbursements to be made to shippers become effective coincidentally with the effective date of tariff provisions of the various railroads authorizing such reimbursement.

JOURNAL BOX PACKING

In response to an inquiry for information regarding the use of substitutes for journal box packing, published in the *Railway Mechanical Engineer* a short time ago, several roads have replied. A brief abstract of the replies follows:

Road A.—We have experienced some trouble in using the cotton journal box packing. It has been found to be short material and has not been giving us the service that we should receive. We have been using cotton packing on freight equipment for some time, but the past year we have had a very poor grade of material.

Road B.—This company has been using cotton waste for journal box packing for some period of time, and we find that if it is kept up to the journal we have no trouble. This waste is inclined to sag a little more than good wool and requires a little more attention. We have been very successful with its use.

Road C.—We did not change our practice during the war but used cotton waste for packing all journal boxes, which has been the practice on this line for the past fifteen years.

Road D.—We have to date made no changes from our pre-war practice. We are using cotton waste for freight cars and a 75 per cent wool and 25 per cent merino waste for passenger cars and tender trucks. We have obtained very satisfactory results.

Road E.—We have not made any changes in our standards for journal box packing. We use cotton waste for packing journal boxes of freight cars and a composite wool cotton and fibre waste for passenger cars and locomotives.

Road F.—It has always been the practice of this road to use wool waste for passenger car journal box packing and a journal box packing composed of wool waste and cocoanut fibre for freight equipment cars. We have not deviated from this practice during the past year, but we have frequently been furnished with wool waste which was of inferior quality to that called for in our specification and were often obliged to take this material, although we did not consider it satisfactory for journal box packing.

The following is taken from our specifications for journal box packing: The material desired under Grade A is curled vegetable fibre, so curled as to impart to it the maximum resiliency; wool and cotton threads free from large lumps of any one component part and thoroughly machined and intimately mixed with the curled fibre in the following proportions. Grade B to have the same quality of wool and cotton as Grade A, without the vegetable fibre.

	Grade A	Grade B
a. Vegetable fibre	15 per cent	0 per cent
b. Wool waste	45 per cent	60 per cent
c. Cotton waste	40 per cent	40 per cent

The vegetable fibre should be Tampico, cocoanut or some approved equivalent, clean, long, strong, well curled and sufficiently elastic. The wool threads should consist of new yarn or thrums from the product of looms weaving Brussels, Axminster and Ingrain carpets and other high-grade woolen fabrics. Muck yarn shall not be used. The cotton waste should consist of white and colored new cotton threads.

Road G.—We have tried several substitutes for wool, but have not been able to secure satisfactory results and have insisted on and secured a journal box packing to the following specification: A shredded carpet stock containing at least 50 per cent net wool content, the balance of the mixture composed of cotton and long merino threads, 2 inches and over. The whole being well machined, free from knots, flyings, jute, sticks, paper or other deleterious substances. Oil, grease and dirt not more than 10 per cent. Moisture not to exceed 10 per cent. Cotton not more than 20 per cent. This is proving very satisfactory.

Road H.—This road has tested, in service, a number of different kinds of journal box packing and our tests indicate that a combination of wool, cotton and vegetable fibre gives the best results. The standard packing now used by this company consists of about 85 per cent wool, 7 to 8 per cent cotton and 7 to 8 per cent vegetable fibre.

Road I.—We have for several months on this road been using wool waste, which is partially made up of shredded carpet. This waste is composed of approximately 67 per cent wool and 33 per cent cotton, and is satisfactory.

Road J.—While a good grade of packing is, of course, better than a poor grade, I believe that 90 per cent of the hot box trouble could be eliminated with the average packing that is used if boxes were given the proper attention. Two of the main troubles have been, first, allowing cars to run until the packing at the back of the journal became dry and glazed; also in extremely cold weather the packing works to the front of the boxes reducing the surface of the journal which is lubricated until the hot box is unavoidable. Second, rebrassing cut journals instead of changing wheels.

The greatest advance that has been made in years in the prevention of hot boxes has been in the discovery that where lubrication is failing or friction is increasing from any cause, the center of the journal on the end becomes dry before the journal becomes hot. A dry journal center is almost an infallible sign of an impending hot box and calls for one of three actions (always examine brass and journal):

1. If caused by dry and glazed dope, with brass and journal in good condition, repack box.
2. If the brass is worn or defective with the journals in good condition, rebrass and repack.
3. If the journal is cut, change the wheels.

Where there is a plug of waste in the front end of the box (I think these will soon all be removed by all roads), a dry spot cannot, of course, develop; but frequently a greasy wheel with a new brass is an indication that a brass has been applied to a cut journal. This journal may run cool if the car is empty, but not when it is loaded.

One cause of an unnecessary number of hot boxes is the practice of applying brasses to cut journals when the wheels should have been removed. This was quite general a year ago, and there has been a great deal of it up until the last few months. A car stops off at various sidings and repair tracks to have brasses changed and thus takes several weeks to get over the road, and it is very difficult to learn what is going on until some person complains of the long delay to a car of important freight. I am fully convinced that if all roads followed these matters closely the hot boxes could be reduced 90 per cent.

We have spread our wheel storage tracks and cut the sides of our wheel cars down so that wheels can be stored without the flanges of the wheels striking against the journals.

A feature in connection with changing or examining the brass is the importance of using two jacks. When only one jack is used the weight on the opposite journal, especially if the car is loaded, usually causes the wheel to raise from the rail with the result that the man usually goes for help and has to use blocks to force the wheel down. In many cases this makes it necessary to drive the brass in with a bar or hammer, damaging the lining as it is forced past the collar and sometimes when there has been end wear on the brass removed, the new brass and wedge are not properly seated, resulting in a brass bearing on one end with the certainty of a hot box.

If a jack is placed under the opposite box and raised just enough to take the weight, the wheels remain on the rail; also if the brass removed is end worn the wheels, being free on the rail, can easily be moved over to allow the new brass to enter. I have seen three or four men take an hour to change a brass with one jack where one man could have done the work in a few minutes with two jacks.

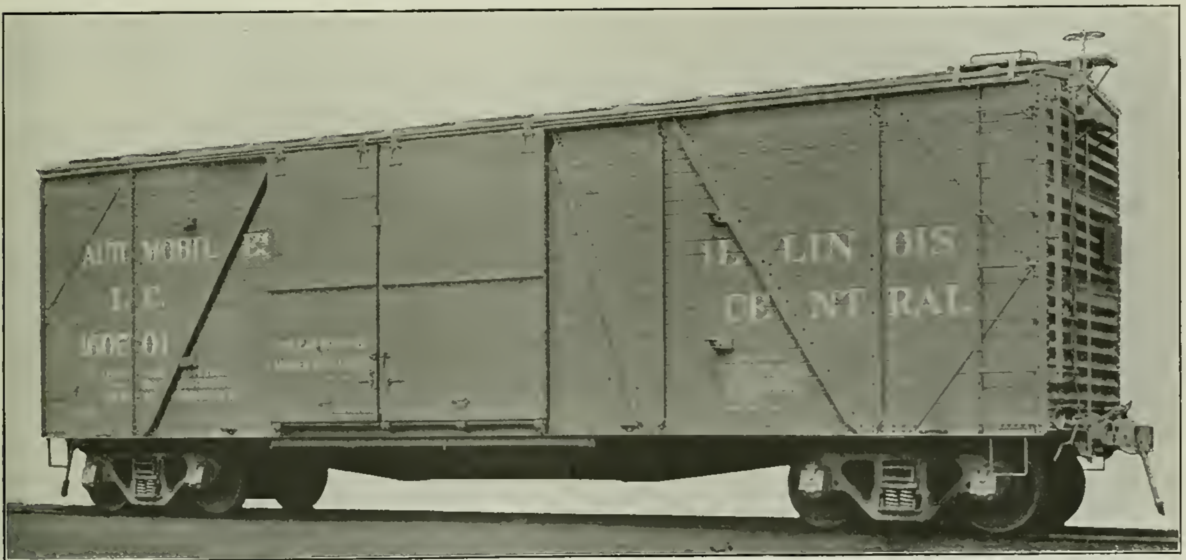
Automobile Cars for the I. C.

Single Sheathed Type of 80,000 lb. Capacity; Designed Particularly for Carrying Various Kinds of Lading

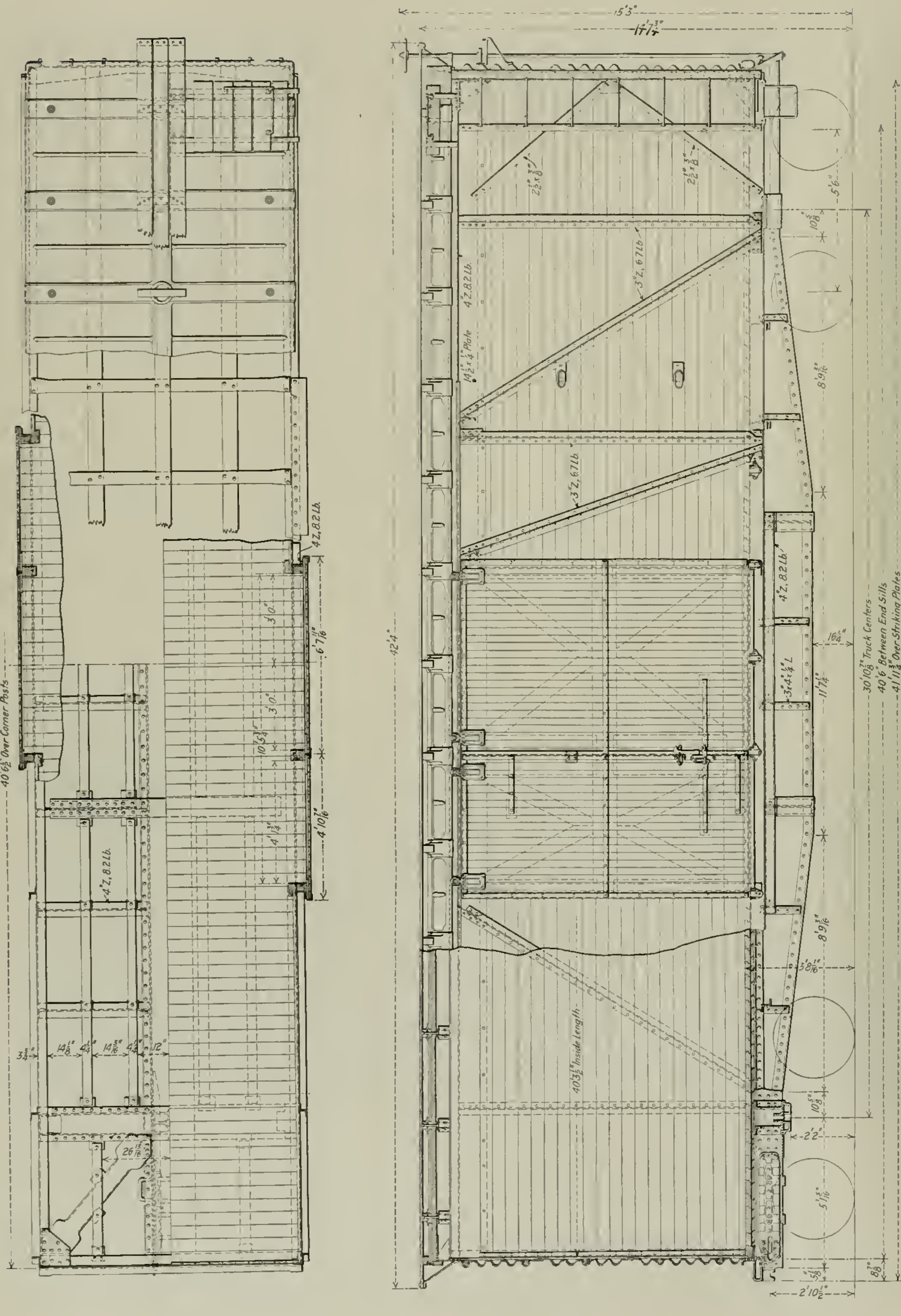
Persistent efforts have been made by many roads during the past few years to secure freight cars which are adapted for many kinds of lading. This policy, if consistently followed out, would undoubtedly bring about a reduction in the empty car mileage and an increase in the average carload. The growing tendency to design cars built for a special traffic, so that they are adapted for various kinds of lading is well exemplified by an order of five hundred 40-ft. automobile-furniture cars of 80,000 lb. capacity recently delivered to the Illinois Central by the Standard Steel Car Company. While designed primarily for automobile and furniture loading, these cars are suitable for almost any commodity that is handled in box cars, excepting grain.

These cars have a light weight of 48,000 lb. They are 40 ft. 3½ in. long and 8 ft. 6⅛ in. wide inside. The height from the floor to the under side of the carlines at the side is 10 ft. ¼ in. The cubical capacity of the car is 3,435 cu. ft. The length over the corner post is 40 ft. 6½ in. and over the striking plates 41 ft. 11¾ in. The width at the ends is 8 ft. 9⅝ in., and between the steel side door posts 10 ft. 5¾ in. The extreme height to the top of the brake mast is 15 ft., 3 in., and to the top of the running board 14 ft. 8 1/16 in. The top of the floor is 3 ft. 8 1/16 in. above the rail.

The underframe is of the fishbelly type. The web plates are 5/16 in. thick and 24¾ in. deep at the center, and 10 11/16 in. at the draft sill, extending continuously from end sill to end sill, being spaced 13½ in. apart. Along the bottom of each web plate is riveted a 5-in. by 4-in. by ⅝-in. angle, with the long flange horizontal. The top chord angles are 3½ in. by 3½ in. by 5/16 in., and to them is riveted a top cover plate 5/16 in. thick and 21 in. wide, extending the full length of the sills. From the inside of the end sill to a point 21 in. beyond the center line of the body bolster, the center sill web is reinforced by a plate 5/16 in. thick extending the full depth of the sill, having at the top, flanges



Illinois Central Single Sheathed Automobile Car

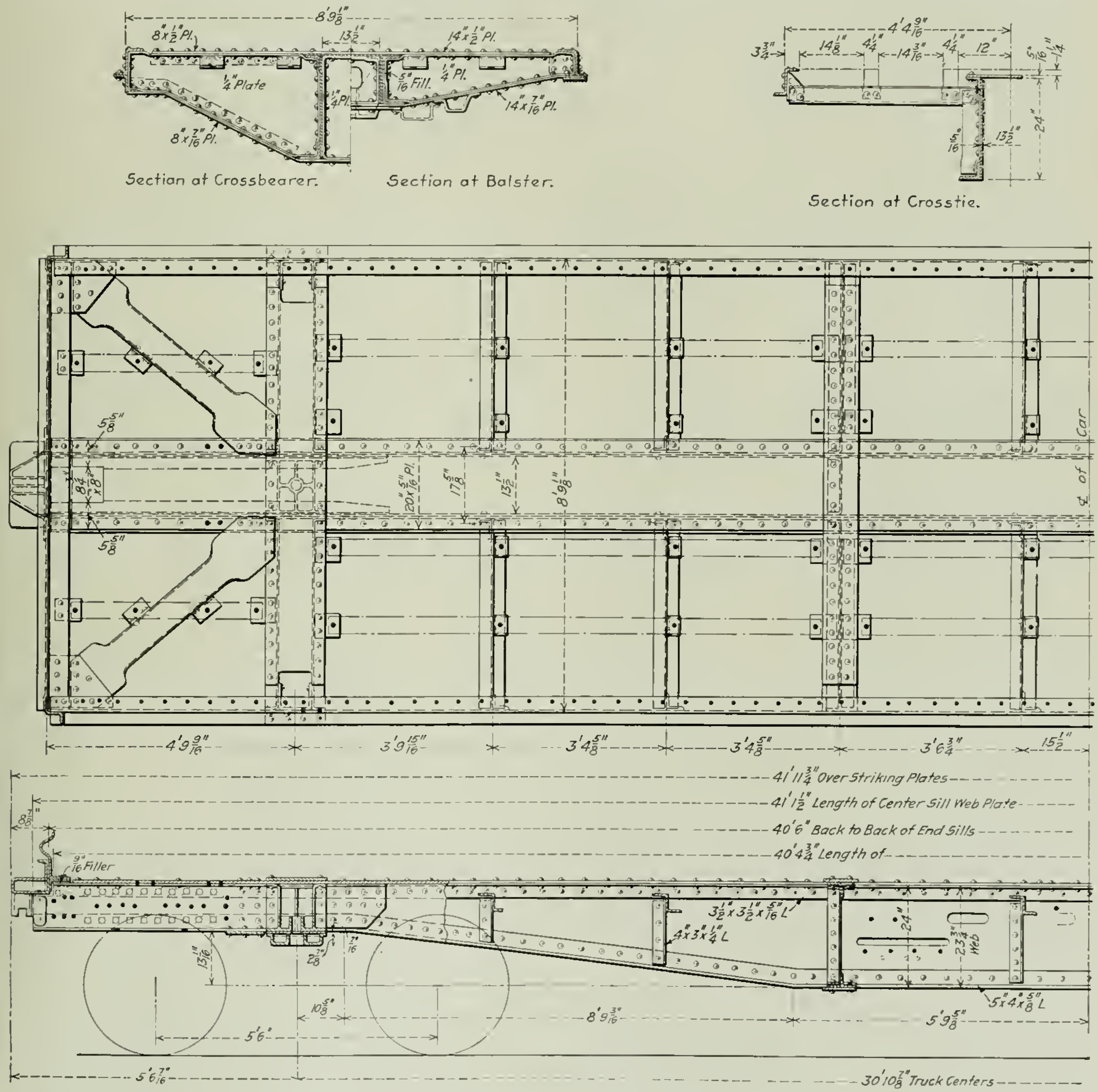


Plan and Elevation of Single Sheathed Automobile Car for the Illinois Central

3 in. wide extending inward. These stiffeners are riveted to the inner side of the center sill web plate and to the cover plate. The web plates are also reinforced between the bolsters by vertical stiffeners of 4-in. by 3-in. by ¼-in. angles, which are spaced approximately 3 ft. 6 in. apart and serve also as supports for the floor beams. Malleable iron cheek plates of the double pocket type are riveted inside the draft sills. The couplers have a 5-in. by 7-in. shank and 8½-in. butt. A cast steel yoke having an ultimate strength of 450,000 lb. is used. It is attached to the coupler by a key and is fitted with one M. C. B. class *G* draft spring and one Harvey friction spring. The Carmer release rigging and Imperial centering attachment are used.

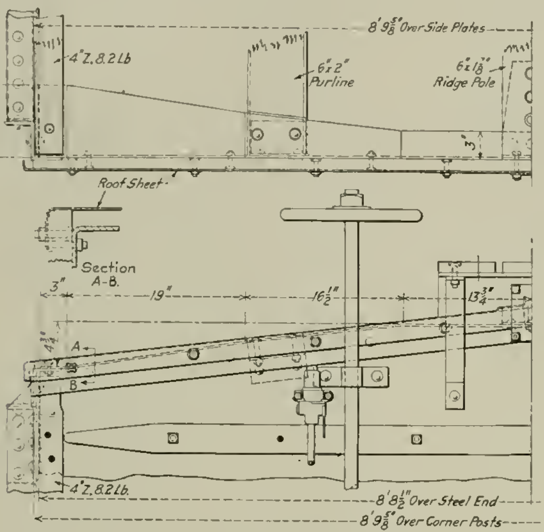
The body bolster is of a box section. The diaphragms are of ¼-in. pressed steel plate with 3-in. flanges all around and are spaced 8 in. back to back. At the outer end of the diaphragm there is a spacer made of a 7/16-in. bent plate. The spacers between the center sills at the bolsters are of cast steel. The top bolster cover plate is 14 in. wide and ½ in. thick extending from side to side sill. The bottom cover plate is 14 in. by 7/16 in. and extends the full width of the car. The cast steel body center plate is fastened under the bottom cover plate and is riveted through the bottom chord angles on the center sills and also to the center sill spacer casting.

The end sills are 8-in., 18.75-lb. channels. To the back of these channels is riveted a 5-in. by 3-in. by ⅜-in. angle by which the end sill is fastened to the top of the center sill. The striking plate is a steel casting riveted to the end sill and to the webs of the center sill. There are two cross bearers on each side of the car, spaced 10 ft. apart. The diaphragms are of ¼-in. plate with a 3-in. flange all around, reinforced at top and bottom by 3-in. by 2½-in. by 5/16-in. angles. A pressed steel filler made of ¼-in. plate is fastened between the center sills at each cross bearer. The top cover plate is ½ in. thick and 8 in. wide.



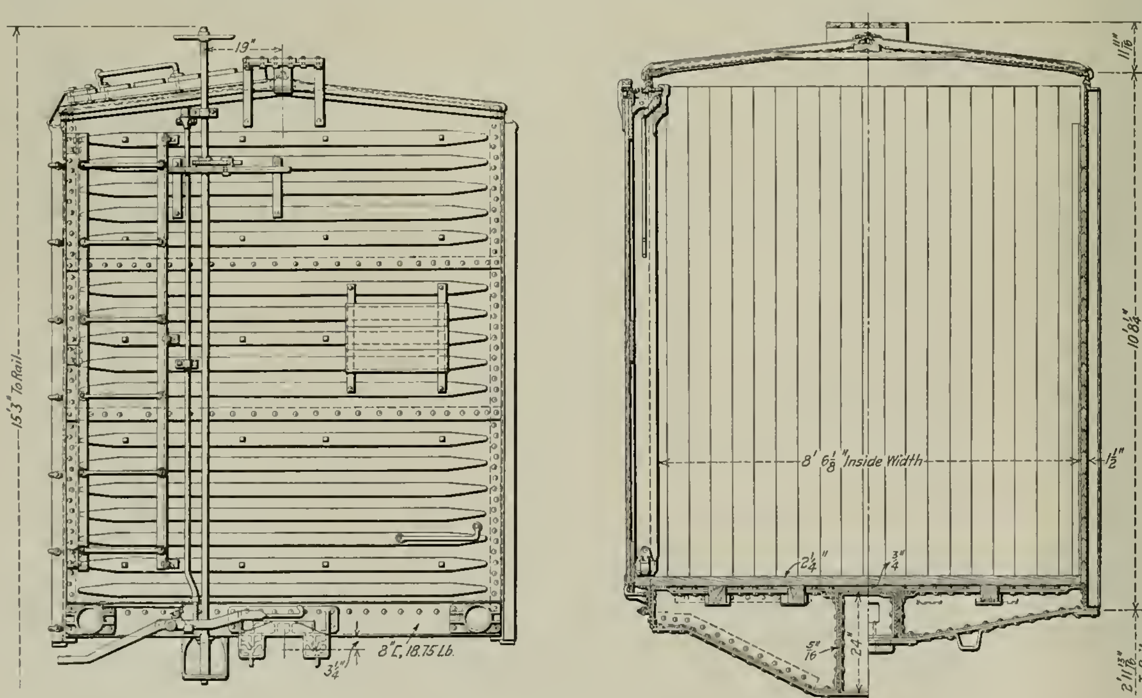
Underframe for the Illinois Central Single Sheathed Automobile Car and extends out almost to the side sill, while the bottom cover plate is 7/16 in. by 8 in. and is fastened directly to the side sill.

The side sills are made up of a 6-in., 16.67-lb. Z-bar of



Arrangement of End Plates and Roof Sheets

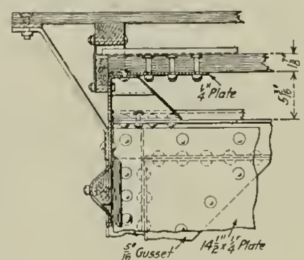
a special section incorporating a grain lock, extending from end sill to end sill. This Z-bar is reinforced under the door opening and for a short distance beyond at each end, by a



End View and Section of the Illinois Central Automobile Car

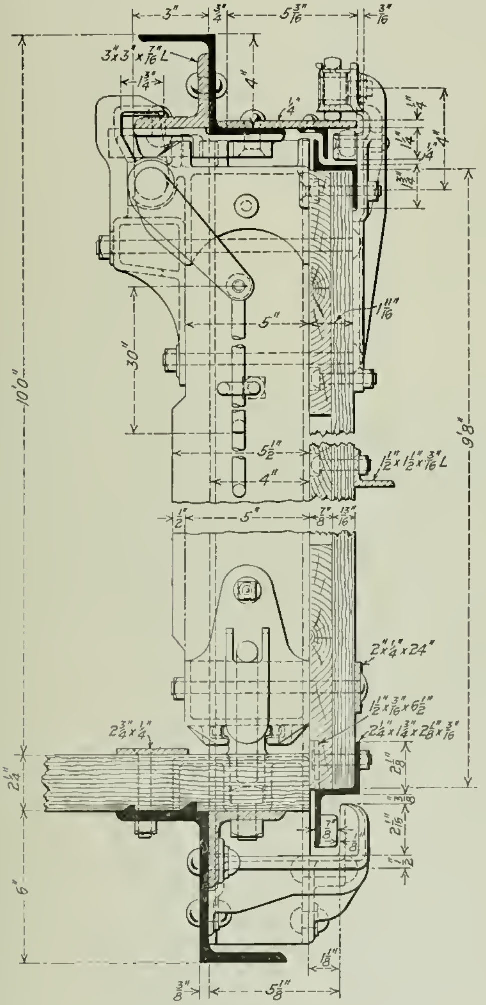
4-in., 8.2-lb. Z-bar riveted to the lower flange of the 6-in. Z-bar. The two sections thus form a channel which fits over the end of the cross bearer, the cross bearer bottom cover plate being riveted to the lower flange. The bottom cover plate of the body bolster is likewise fastened to the outwardly extending flange of the 6-in. Z-bar and a malleable iron jacketing casting is placed beneath the cover plate. The side sills and end sills are riveted together at the corners and are reinforced by a 5/16-in. plate. There are diagonal braces extending from the corner of the underframe to the intersection of the center sill and body bolster, made up of 3/8-in. plate 12 1/4 in. wide, flanged in the center to a channel section. There are six floor beams on each side of the car made of 4-in. Z-bars riveted to the center sill stiffeners and to short sections of 4-in. by 3-in. angles riveted to the side sills.

The corner posts are 4-in., 8.2-lb. Z-bars and the side posts and braces are 3-in., 6.7-lb. Z-bars, with the exception of the door posts, which are of the same section as the corner posts. The posts and braces are joined at the top of the 14 1/2-in. by 1/4-in. side plate girder which extends from the end post to the door posts and is riveted to the web of the 4-in. Z-bar side plate. The side plate is reinforced at the center by a 3-in. by 3 in. by 7/16-in. angle riveted to the web of the Z-bar and overlapping the side plate girder for a distance of 2 ft. at each end. The end posts are braced by 2 1/2-in. by 3/8-in. diagonal end straps and also by flanged corner angles made from 5/16-in. plate.



The end is of the Murphy pressed steel type, the two lower sections being of 1/4-in. plate and the upper sections of 3/16-in. plate. The bottom section is flanged inward, and is riveted to the 5-in. by 3-in. angle on the inner side of the end sill. Five transverse furring strips are provided to hold the end lining.

The floor of the car is supported on yellow pine stringers 4½ in. wide and 4 in. high. Between the body bolster and the end sill there is but one stringer on each side, but in the center of the car there are two. The stringers are continuous over the floor beams, but end at the cross bearers to which they are attached by short sections of Z-bars riveted to the upper flange. The flooring is 2¼-in. yellow pine, shiplapped, bolted to the side sills and nailed to the stringers. The siding is 1½-in. by 5¼-in. yellow pine, tongued and grooved, bolted to the posts and braces. The lower course of the siding fits over one of the ridges on the side sill, thus forming a grain lock. The siding extends to the



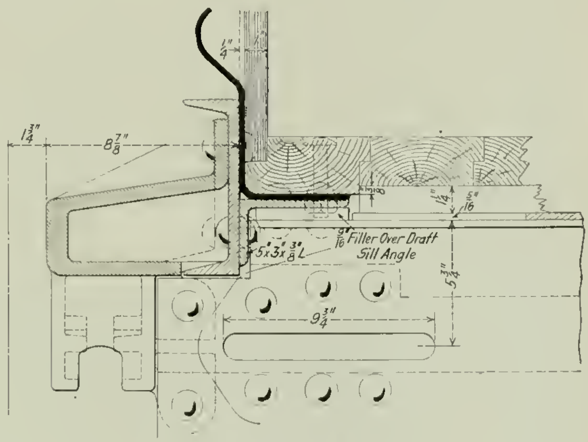
Side Door Post and Sections of Side Framing at Door

steel end sheet and an angle iron is fastened in the corner where it meets the 1-in. end lining, this angle being bolted through the side lining and the web of the corner post and also to the corner board in the end lining.

The door posts are spaced 10 ft. 5¾ in. apart, and are staggered, the distance from the center line of the car being 3 ft. and 7 ft. 5¾ in. respectively. There is a movable center door post of white oak, 4 in. by 5½ in., with top and bottom shoes of malleable iron engaging malleable housings, one on the side plate and the other in the floor. When the center post is moved over adjacent to the door post, there is a clear door opening of 10 ft. 1¾ in. When it is brought over to the point where the two doors meet it is automatically locked in position and can be bolted to the frame of the smaller door leaving an opening which is six feet wide.

The doors have steel frames made up of Z-bars at the top and bottom and angle irons at the sides with a transverse reinforcing angle across the center. The stiles, rails and braces are ⅞ in. and the sheathing is 13/16 in. thick. Camel door fixtures are used throughout.

The roof is supported on 13 carlines made of ¼-in. pressed steel plate and riveted to the top flange of the side plate Z-bar. The roof is of the all-steel type with galvanized sheets of No. 16 U. S. gage. The trucks are of the Vulcan cast steel type with cast steel truck bolsters equipped with Barber lateral rollers and a drop forged truck center plate. Brake beam safety bars made of 3-in. by 3-in.



Section Through End Sill

angles are attached to the spring plank. The air brake is the New York Air Brake Company's schedule CF-C-10 with J. M. expander ring.

SHOPPING RECORD FOR PASSENGER CARS

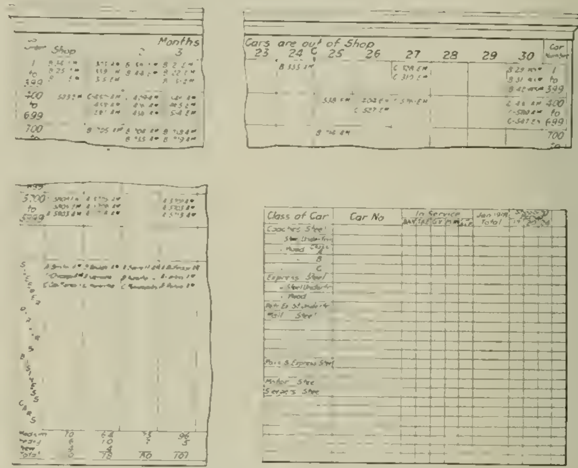
In the offices of passenger car shops it is necessary to keep records of the shopping of individual cars from which to prepare lists of equipment due for shopping. The usual form of book record is not entirely satisfactory for this purpose, as it does not make readily available the general data which are often of extreme importance. For instance, if information is desired concerning the number of cars which will be due for shopping in any particular month, it is necessary to check the records of every car unless separate statements are prepared on which this information is shown. The Chicago, Milwaukee & St. Paul has in use at its Milwaukee shops an ingenious arrangement called the passenger shopping record board, which makes it easy to compile such data and shows the condition of the equipment almost at a glance.

In order to give a clear explanation of the working of this device it is necessary to state some of the general rules governing the passenger car work. The road makes a practice of overhauling cars at regular intervals as follows: steel cars 17 months, steel underframe cars 20 months, wooden cars 24 months. The cars may receive light repairs for some special reason, but this does not affect the shopping period.

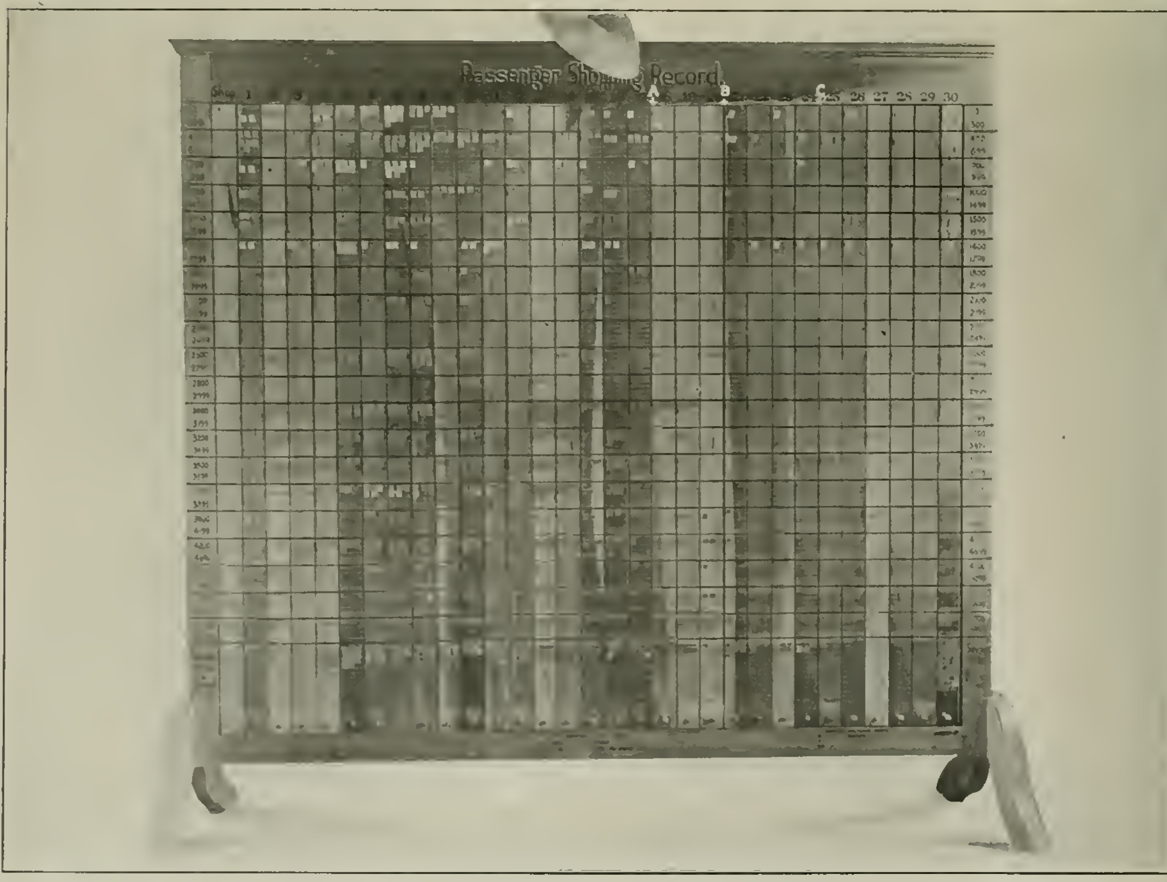
There are four shops where general repairs are made located at Milwaukee, Wis., Minneapolis, Minn., Dubuque, Iowa, and Tacoma, Wash. Repairs are classified as medium or heavy repairs and rebuilding, and some new cars are built.

The shopping record furnishes information concerning the cars and the last shopping in a convenient form. The record is kept in a frame approximately 8 feet high and 9 feet wide, this large amount of space being necessary, as the road has 1,670 passenger cars. The frame carries 31 narrow vertical panels in which are inserted small cards, each of which represents a passenger car. These panels slide in grooves along the top and bottom of the frame and those at each end are held in place by latches and can be removed if desired. The panel at the extreme left carries cards for the cars in the shops, the next has the card for all cars out of the shops one month, and so on across the board, the last panel carrying the card for all cars out of the shops 30 months or longer. The panels are divided into sections for the various series of cars, and in this way the different types as steel coaches, wooden coaches, express cars, etc., are separated. The cards, which are inserted in slots in the face of the panels, are of three different colors, red for steel cars, blue for steel underframe cars and white for wooden cars. On each card there are distinguishing marks to show the type of car (steel, steel underframe or wood), the number or name, the shop at which it was last repaired and the class of repairs it received. For example, a typical notation would be as follows: A-5718-A-M. The prefix *A* indicates that this is a steel car due for shopping at intervals of 17 months, the number shows that it is a tourist sleeper and the suffix *A-M* that it received its last shopping at Milwaukee, and was given medium repairs. If this card was shown in panel No. 7 it would indicate that the car had been repaired seven months before.

At the top of the frame between panels 17 and 18 is a letter A, indicating that steel cars beyond this point are due for shopping. It is easy to check over the red cards in



Monthly Blueprint Record of Car Repairs



Board for Keeping Record of Passenger Car Repairs the panels to the right of the letter and determine the number of steel cars which require repairs. Similarly, the limits for the steel underframe and wooden cars are shown after 20 and 24 months, respectively. When a car comes into the shop for classified repairs, the old card is removed from the rack and a new card is made out and placed in the shop panel. At the first of each month the board is changed. Panel No. 30 is removed and placed in the shop column, moving each board one column to the right. Cars overdue for the shop and not yet brought in are replaced in panel No. 30, and cars still undergoing repairs are replaced in the shop column.

The passenger shopping record is located in the office of the general supervisor of passenger cars. While this is convenient for the main shop, it is desirable to have the same information available in the other shops, and for that reason the record as it stands at the first of each month is reproduced on a tracing, and blue prints are sent to all shops on the system. This blue print also has a list of the classes of cars, the numbers and the roads to which they are assigned. In addition it has a summary of the repairs for each month and a statement of the number of cars overdue for repairs, with comparative figures for the two preceding months. From the description given above, it is easy to see how readily the shopping record in this form can be analyzed to obtain any information desired as, for instance, the number of cars of any series overdue for the shop, the number of steel or wooden cars that will fall due for shopping in any particular month, etc. On any road having a large number of passenger cars, such a device will prove very useful.

Freight Car Repair Standards

Government's Requirements Ambiguous; Interpretations Needed If Extravagance Is to Be Avoided

BY A MECHANICAL ENGINEER

A CLOSE study of the effort to establish "Material Standards for Freight Car Repairs," as outlined in U. S. R. A. Mechanical Department Circular No. 8 cannot but serve to convince the unprejudiced reader that it contains many ambiguities which are difficult of interpretation, that in many cases its observance is impracticable, and in other cases if followed would accomplish the introduction of the specified standards only at an expense totally unwarranted by the actual benefits realized. The introductory clause of this circular reads: "When renewing parts or applying betterments to freight cars owned by railroads under federal control, if suitable material, either new or second-hand, that is standard to the car, is in stock, it shall be used. Where such material is not in stock, material standard to United States standard cars should be used, if available."

Interpreting the above clause in strict accordance with its reading, it would appear that should parts "standard to the car" not be in stock they may not be manufactured or purchased even if readily available by manufacture or purchase, and regardless of all considerations of economy of repairs "material standard to the United States standard cars should be used, if available." Just what does "if available" mean, and to permit the observance of the most elementary principles of economy should not the conclusion of these general instructions have read, "*if readily applicable to the cars to be repaired?*"

Some of the rules set forth appear to be particularly impracticable of application and unwarranted.

Rule No. 3 reads: "Side bearings—If body or truck side bearings require changing, or renewing, frictionless type should be used, interchangeable in capacity and dimensions with those used on United States standard cars."

The committee appointed to consider the general subject of freight car repairs doubtless acted in accordance with its best judgment in deciding to extend the use of a device standardized for new cars by adopting it for repairs to cars in service. Nevertheless, it would seem that frictionless side bearings had not received a sufficiently strong majority endorsement by railroad mechanical department heads to warrant anything more than their recommended use in freight car repairs where conditions permit application without radical change in body or truck bolsters. Any one with a knowledge of the varying side bearing conditions obtaining on the multiplicity of freight car designs in service today can appreciate the problem involved in replacing the ordinary rub side bearings with the frictionless type interchangeable in dimensions with those used on United States standard cars. In many cases such replacement could not be effected for lack of space between the bolsters at the point of attachment of the side bearings; in other cases because the side bearings are cast integral with the bolsters.

As to the stipulated "interchangeability in capacity" with frictionless side bearings used on United States standard cars, an investigation will show that frictionless side bearings have not been and are not rated in accordance with capacity, the efforts of each individual designer being all in the direction of the development of devices whose several parts would continue to function properly and which could be maintained in working condition at minimum cost under the maximum side bearing loads generally obtaining.

Rule No. 4 reads: "Side truck frames—When necessary to renew side truck frames, cast steel U-shaped section, United States standard car type, with separable journal boxes, to be uesed."

The superiority of the cast steel side truck frame to the built-up arch bar type in rigidity, ultimate strength and durability no doubt justified its selection for the United States standard cars, but from the standpoint of supply available for quick repairs there are many who will question the propriety of designating the U-shaped section to the exclusion of the several T-shaped section designs that have given satisfactory service.

With respect to the specified exclusive use of the cast steel truck side frame for renewal of side frames in service: The intent and purpose of rule 4 evidently is the gradual elimination of all arch bar side frames and their replacement by the cast steel U-shaped section United States standard car type. A rigid adherence to this rule would obligate all railroads to immediately secure and carry a stock of the standard cast steel frame. Further, the wording of this rule is so indefinite that it seems necessary that supplementary instructions be issued stating the extent of failure which would constitute sufficient cause for renewal; that is, what proportion of the several members of the arch bar side frame should fail to warrant complete replacement with the cast steel side frame in preference to making easy and quick repairs by renewal of one or more of the individual parts.

The very extensively used M. C. B. arch bar side frame, being a built-up structure composed of solid rectangular bars, columns and column bolts, is very seldom subject to failure in its entirety, and as all of its component parts have been M. C. B. standards for many years and as such are carried in stock by all railroads, this type of side frame lends itself to quick and economical repairs.

The quite extensive adoption and use in recent years of cast steel side frames of the pedestal type, requiring a design of journal box differing from the strictly M. C. B. standard type, presents an obstacle to the use of the standard side frame required by rule No. 4 in making renewals that could be overcome only by entire disregard of all consideration of economical repairs. It can be readily seen that in replacing a failed side frame of this pedestal type with the United States standard car type it would necessitate scrapping the journal boxes or assigning them to storeroom stock for a possible future need which might never develop.

Rule No. 6 reads: "Draft gears—(a) Friction draft gears, either Cardwell, Miner, Murray, Sessions Type 'K' Westinghouse, or similar gears, to be of not less than 150,000 pounds capacity with a maximum travel of 2¾ in.

"(b) Spring draft gears, if used, to be at least equal in capacity to two M. C. B. Class 'G' springs, interchangeable with friction gear without change in car construction.

"(c) Clearance between coupler horn and striking casting to be 3 in.

"(d) Coupler to be key connected to draft gear."

Clause (b) of rule 6 seemingly permits the use of spring draft gears of a minimum capacity of 60,000 lb., but the qualifying stipulation reading "interchangeable with friction gear without change in car construction" effectually nullifies this seeming concession, as the most casual investigation will show that no known modern arrangement of draft castings suitable for tandem or twin M. C. B. class "G" springs can be designed so as to likewise provide for friction draft gears.

This qualification being present in rule No. 6, the use of friction draft gears becomes obligatory on steel reinforcements (either draft arms or through center construction) applied to wood underframe cars, or in the replacement of spring draft gears on steel cars where suitable draft attachments standard to the car are not in stock.

The difficulties and expense incident to replacing spring draft gears, either tandem or twin, on the many steel cars so equipped, by friction draft gears are too obvious to dwell upon, and if investigated would convince operating officials of the entire impracticability of this clause of rule No 6 and the enormous expense entailed.

Metallic draft arms in the past ten years have been found a very satisfactory, adequate and economical means of reinforcing wood underframe cars, but under rule No. 6 such draft arms must now be used in conjunction with friction draft gears. This brings about the concentration of the entire buffing shock on the center line of draft, with a resultant moment of force about the neutral axis of the section of draft arms above the bolster (which is limited by the design of the car) of such magnitude that stresses will be set up in the metal that are in excess of its elastic limit. This condition does not obtain with a 60,000-lb. capacity spring draft gear and a 2-in. coupler horn clearance, because the buffing shock delivered on the center line of draft is limited to the spring capacity, after which, with the coupler horn in contact with the striking plate the eccentricity of shock is very materially reduced. In other words, in using spring draft gears with metallic draft arms and two-inch coupler horn clearance it is possible to keep within the M. C. B. maximum ratio of unit stress to end load of .15, while in many cases it is not possible to meet this requirement with friction draft gears. Are we to eliminate an altogether satisfactory and economical method of reinforcing wood underframe cars which, when used in conjunction with spring draft gears can be designed to meet a very essential M. C. B. requirement, but which in many cases cannot be so designed when combined with a friction draft gear in an underhung draft rigging?

The foregoing is predicated in the case of spring draft gears on a clearance of two inches between the coupler horn and striking casting. Clause (c) specifies a three-inch coupler horn clearance, but when and how this is to be obtained is left to the ingenuity of the railroad making repairs. On many existing designs of underframes its reduction to practice would result in overstressing the center or draft sills between end sill and bolster.

The statement is ventured that in the opinion of many mechanical department heads spring draft gears are entirely satisfactory on any design of adequate steel reinforcement for wood underframe cars and that the greatly increased cost of applying friction draft gears to equipment of limited life and value is not justified.

Rule No. 8 reads: "Doors—Side doors on box or stock cars (except double deck stock cars) will be bottom supported and the attachments uniform with those on United States standard cars."

While there may be but few railroad men who will question the superiority of the bottom hung side door to the top hung door, it is difficult to understand the viewpoint of the committee on car repairs in making the bottom hung door an absolute requirement for repairs. In many cases this would necessitate extensive alterations at the side plate and side sill, and possibly involve rebuilding the doors themselves at a cost many times greater than that involved in merely replacing all the original door fixtures.

Rule No. 9 reads: "Ends—Box cars with weak constructed ends requiring two-thirds of end to be renewed should be reconstructed as follows:

"(a) Horizontal corrugated steel ends (two or three-piece) having top section three-sixteenth inch thick, and bottom section or sections one-fourth inch thick and corrugations 2¼ in. deep.

"(b) Vertical reinforced ends with 4 or 5 in. 'Z' bars securely fastened to place on end sills and end plates. End plates to be diagonally braced on inside of car, under roof, to side plates, or with reinforcements equivalent in strength."

While a certain latitude is permitted in renewing weak constructed ends because of the two different methods stipulated, an analysis of clause (a) of this rule discloses the fact that it becomes necessary to use one proprietary structure, notwithstanding the fact that the U. S. R. A. specifications for new cars permit the alternate use of three different types of steel ends. To those railroads to whose cars another design of steel end might be more economically applied the injustice of this very narrow restriction is most apparent.

Rule No. 12 reads: "Roofs—When roofs are changed or renewed, outside flexible type metal roof made of 22 or 24 gage galvanized iron with mullions between roof sheets and with flexibility at eaves and ridges, will be applied. Roofs should be interchangeable with United States standard cars having same length and width sheets. To permit the use of standard sheets, the following changes may be made:

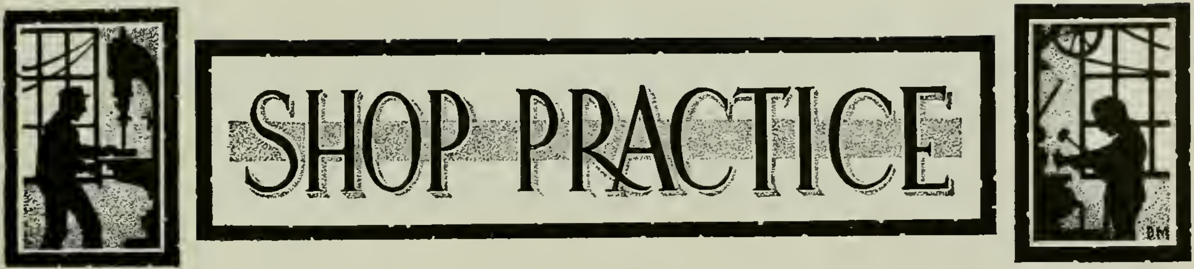
"(a) Increase or decrease in thickness, or omitting eave molding, fascia, or both.

"(b) Increase the width of roof flashing at eaves.

"(c) Where cars are equipped with all metal roofs, such construction may be continued when renewals are necessary, if considered desirable."

The effect of this rule on freight car repairs and its practical application is largely a question of interpretation. Taken by itself its observance is required only "when roofs are changed or renewed," but when linked up, with the introductory clause of the circular, it apparently becomes necessary to remove without regard to expense a partly worn-out all-wood or inside metal roof.

There are many who endorse the benefits and economy to be derived from standardized freight cars and locomotives building and hereafter built, while there are also many who oppose such rigid standardization as has been adopted for United States standard cars, but those who advocate standardized new equipment could not pursue a plan better calculated to discredit their views than by acquiescence in the enforcement of Mechanical Department Circular No. 8. If held to be mandatory and put into execution, it would add such a burden of increased cost of freight car maintenance as to rival the increase in direct labor operating costs already imposed by government control. It is an abortive attempt to extend standards never originally contemplated for anything but new cars of one general predetermined design to some two million (2,000,000) cars of a multiplicity of designs now in service without regard to the enormous cost involved, and it would seem that the Railroad Administration in approving it had acted with a very indefinite knowledge of what its actual reduction to practice would mean.

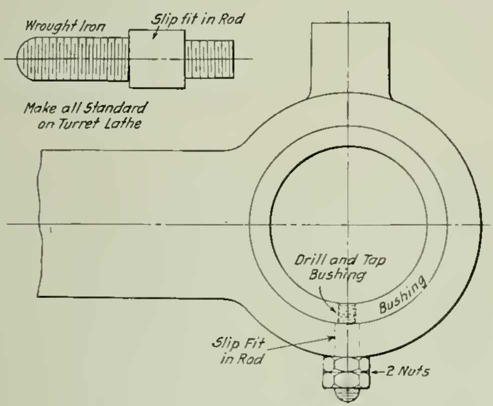


AN IMPROVED KEY BOLT FOR PARALLEL RODS

BY J. H. HAHN
Assistant Roundhouse Foreman, Norfolk & Western, Bluefield, W. Va.

The illustration shows an improved key bolt for securing the bushings in locomotive side rods. The bushings are applied in the usual way and the rod and bushing drilled, the bushing being tapped to receive the key bolt, which is applied with a stud driver and screwed up to the shoulder good and tight. The rod and the bushing is drilled in one operation and, owing to the fact that the hole in the bushing is smaller than the hole in the rod, a drill having two sizes is made especially for the purpose. Also in tapping the bushing a small case hardened bushing that serves as a guide for the tap is inserted in the bushing and, after tapping the hole in the rod bushing, is removed.

On the heavier classes of locomotives considerable trouble is experienced with the bushings getting loose, and whenever



Key Bolt for Holding Bushings in Side Rods

this happens it becomes necessary to remove the rods and shim the bushings, and when a middle connection side rod has to be removed for loose bushings it means quite an item for labor and time the engine is out of service. This rod key bolt was designed to eliminate a great deal of this trouble. If, when this key bolt is used, the bushing gets loose in the rod it can be held firmly in place by tightening the inside nut shown on the stud and locking it with the lock nut. As an additional precaution a cotter can be applied to the end of the stud. This will securely hold the bushing and permit additional mileage. As a matter of fact this can be repeated until the bushing becomes too large for the pin when, of course, it will become necessary to apply a new bushing.

The writer has applied quite a number of these key bolts and has always found them satisfactory. The key bolts can be made on a turret lathe and carried in stock ready for use.

RAILWAY WOMEN EMPLOYEES

The annual report of Director General McAdoo to the President contains a summary of the number of women employed and the character of the work for the dates of January 1, April 1, July 1, and October 1, 1918. The total number of all classes of employment has increased as follows: 60,555 on January 1, 65,854 on April 1, 82,370 on July 1, and 101,296 on October 1. The occupations served by the women are divided into 21 classes, which are shown in the following table, with the number of employees in each class on October 1, 1918:

Attendants	2,390
Bridge tenders	12
Car department	684
Clerical or semi-clerical	73,285
Cleaning	5,555
Elevator operators	97
Messenger service	736
Personal service	2,796
Roundhouse work	1,365
Shopwork	5,091
Signal service	220
Station agents, assistants and agent operators	377
Supervisors of women employees	113
Switch tenders and other yard work	50
Telegraph operators	2,396
Telephone operators (train orders, blocking and reporting trains)	2,613
Track work	872
Train service	100
Warehouse and docks	1,461
Watch women	518
Other service	565
Total	101,296

It will be seen from the above that the largest group is included under "clerical or semi-clerical," in which there are 73,285, or about 72 per cent of the total number. Of the remainder, 11,864, or 11.7 per cent, were employed chiefly in mechanical department work, being divided as follows:

Car department:	
Coach and car carpenters, helpers and apprentices	65
Coach and equipment painters	52
Coach and car repairers	46
Pattern makers, helpers and apprentices	3
Upholsterers and seamstresses	124
Other car work	394
Total	684
Cleaning:	
Car cleaners	3,704
Stations and offices	1,286
Shops	284
Other cleaners	281
Total	5,555
Messenger service:	
Day work	727
Night work	9
Total	736
Roundhouse work:	
Calling crews	66
Cleaning headlights and lanterns	20
Roundhouse clerks	204
Supplying engines	27
Wiping engines	1,000
Turntable operators	48
Total	1,365
Shopwork:	
Blacksmiths, helpers and apprentices	35
Boilermakers, helpers and apprentices	6
Coppersmiths, sheet-metal workers, pipe fitters, helpers and apprentices	14
Electricians, helpers and apprentices	36
Laborers (inside work)	3,316
Laborers (outside work)	1,314
Machinists, helpers and apprentices	370
Total	5,091

While the total number of women employees increased from 60,555 on January 1 to 101,296 on October 1, an increase of 67 per cent, the number employed in the classes pertaining particularly to the mechanical department, as above mentioned, increased from 5,978 on January 1 to 11,864 on October 1, or an increase of 98½ per cent.

INTERESTING SHOP DEVICES AT TRANSCONA

BY S. LEWIS
General Foreman Blacksmith, Canadian Government Railways, Transcona, Man.

No department of a modern shop engaged in either manufacturing or repair work has any greater effect on the output of the plant than the tool department. The Canadian Government shop at Transcona, Man., appreciates this fact, and is well equipped with modern tools and jigs for facilitating work and for reducing the cost of production. Every encouragement is given the men by the management to devise special devices for doing their work easier and in a shorter space of time. The following is a description of three devices that have given particularly good results.

JIG FOR MAKING GREASE PLUG NUTS

Fig. 2 shows a simple and effective jig for boring, facing and tapping nuts for grease plugs, which was designed by J. Darlington, foreman of the machine shop at this point. This device, which is attached to an ordinary drill, has two

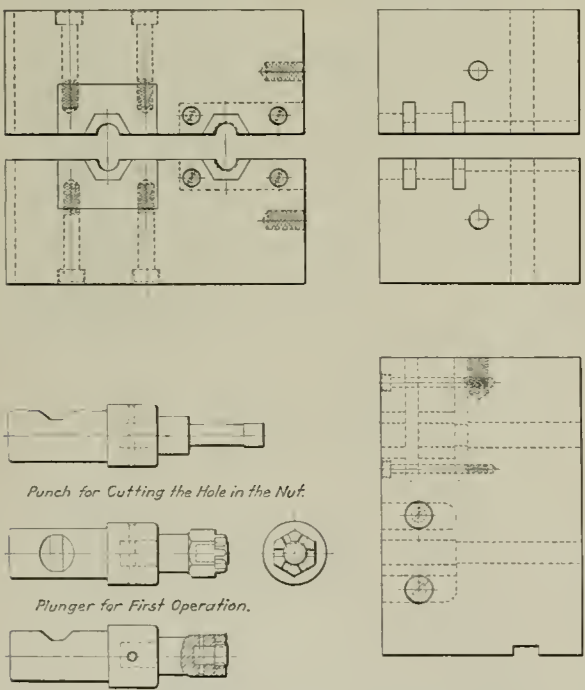


Fig. 1—Dies and Plungers for Making Castellated Nut

sliding V-blocks on top, which hold the hexagonal nut during the operation. These blocks are operated by adjusting screws as indicated in the illustration, which enable tne operator to locate the nut directly over the center of the hole in the jig.

In the base of the jig there is a brass bushing which acts as a steady rest for the boring bar, in which are located two cutters, the lower one boring the nut and the upper one facing it. Both operations are performed with one setting.

An ordinary tap, arranged as indicated in Fig. 2, is used for tapping the nut. The square head of the tap fits into

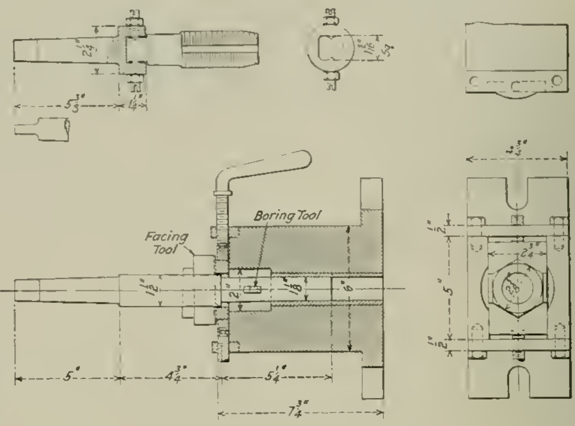


Fig. 2—Jig for Finishing Hex-Nuts

a socket and is held in place by two screws, having lock nuts, which are located on opposite sides of the socket.

Previously this work was done on a lathe, and it took from

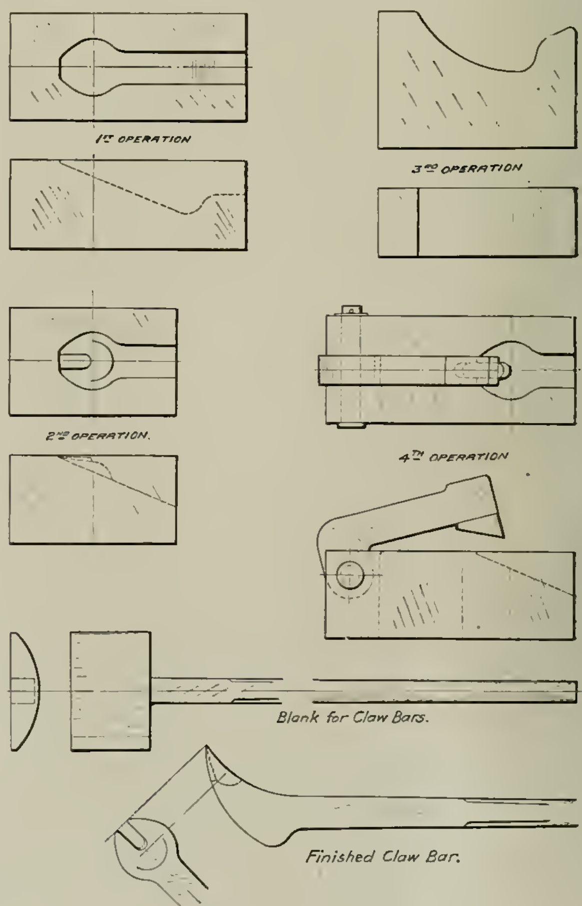


Fig. 3—Dies for Making Claw Bars

14 to 15 minutes to properly finish it, but with this jig on an ordinary drill this nut can be finished in 3½ minutes.

DIES FOR MAKING CASTLE NUTS

A set of dies and plungers used on a 2½-in. Ajax forging machine for making 1-in. castle nuts is shown in Fig. 1. With this equipment these nuts can be produced in one heat with three blows and without wasting the stock. The dies are made in two pieces to facilitate machining operations, and so that the working parts may be renewed without difficulty. The body of the dies is of mild steel, and is made from scrapped axles, while the working parts are made of Peerless *A* steel, which is hardened in air.

The first operation is performed by the plunger, two views of which are shown at the bottom of Fig. 1. It upsets and forms the castellated grooves in the head of the nut. It is of simple construction, being made in three parts, so that the wearing parts may be easily renewed. The body is made of mild steel and the other parts of 60-point carbon steel. The outside of the plunger is provided with six wings on the outside and has an inserted member for forming the inside of the nut. The punch for cutting the hole is shown above the forming plunger. Its functions are to complete punching the hole in the nut and at the same time sever the bar from the nut. It is made in two parts, the body being mild steel and the punch 60-point carbon steel. The diameter of the bar stock used for making the nuts must not exceed the root diameter of the thread in the finished nut.

CLAW BAR DIES

Fig. 3 shows a set of dies used under the steam hammer for making claw bars. These were designed by George Weston, blacksmith at this point. Four sets of dies are required for this work. The first operation gives the necessary deflection to the prepared blank. The second operation more completely forms the nose of the tool. The third operation definitely shapes the head of the bar, and the fourth operation completes it. The claw bars are made from scrap tire steel and weigh about 28 lb. The dies are simple and produce a very satisfactory bar at small expense.

Spot Welding Railroad Tinware

Illinois Central Finds Process Applicable on Wide Range of Work; Cost Materially Reduced

A LARGE proportion of the sheet metal work used on railroads is subjected to rough usage and for that reason it must be strong if it is to give satisfactory service. In order to secure the required strength, the joints in many cases must be riveted. Riveting is slow and therefore an expensive operation, especially when the rivets must be soldered to prevent leakage. The process of spot welding has been applied to the manufacturing of sheet metal ware during the past few years with great success. As the simplicity of the process and the great strength of the joints seemed to make it well adapted for railroad work the Illinois Central about a year ago investigated the possible savings that could be effected and purchased a 10 kw. automatic welding machine, manufactured by the Automatic Electric Welding Machine Company, New York.

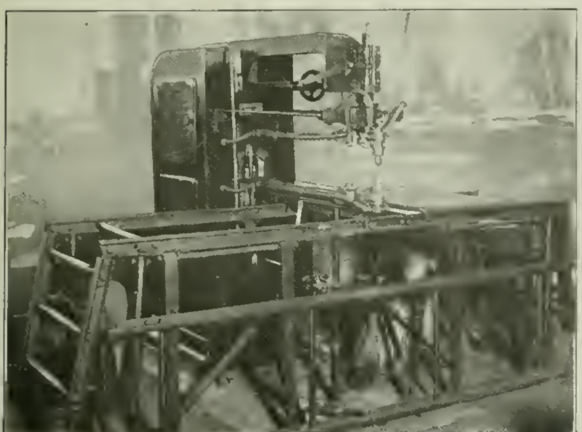


Fig. 1—Automatic Spot Welder of 10 kw. Capacity Used at Burnside Shops

A general view of this machine is shown in Fig. 1. It consists of a case containing the electrical mechanism with two arms extending from the front to which the electrodes are attached. The lower arm can be moved vertically by a screw engaging a crosshead at the front of the frame. The upper arm is stationary, but the electrode is mounted on the end of a bell crank operated through a horizontal rod from a cam in the body of the machine. This machine has a three speed transmission driven by a ½-hp. 220-volt A. C. motor. A hand wheel at the left of the upper electrode varies the speed to give one revolution in one, two or four seconds. On the cam shaft is a magnetic clutch operated by a pedal switch on a flexible cable. If the operator presses his foot on the switch once, the machine makes one weld, but if he holds his foot on the switch one weld will follow another at regular intervals, depending on the speed for which the machine is set.

The cam action is transmitted to the bell crank through a lever and then through a horizontal pressure rod. The lever has an adjustable fulcrum providing a lift of ¼ in. to 1½ in. for the upper electrode. The pressure of the electrode on the work is changed by a hand wheel which varies the stress on the spring in the pressure rod to the bell crank. The electrodes are cooled by a continuous flow of water. The points have a Morse taper fit and are adjustable for various types of work.

The time during which the current flows is regulated by a hand wheel on the right side directly opposite the speed control. The time can be varied by small increments from zero to two seconds which makes it possible to weld from the thinnest stock up to ⅜ in. on this machine. The capacity is dependent on three factors, the amperage of the transformer, the current between the electrodes and the length of time the welding current flows, all of which are automatically controlled in the machine, after the original adjustment has been made. The machine when once set for the gage of stock involved is automatic in its action. The amperage, pressure and time are adjusted by a foreman or electrician thoroughly familiar with the work of electric spot welding, after which any operator capable of feeding the work can secure perfect welds. The automatic features of the machine are important in reducing the cost of labor and in eliminating the waste due to burning or imperfect welds resulting from poor judgment on the part of the operator.

The machine installed at Burnside has proved well adapted for work on railroad tinware. It welds bright tin and black sheet iron very readily. The parts must be flat so that a good contact will be made between the contact points and the surfaces must be free from rust. Galvanized sheets are more difficult to weld satisfactorily, but by using a slow speed and a comparatively low current with small contact points the zinc coatings can be pierced and a good junction secured. In making ventilator screens it has been found quite feasible to weld brass screens to the galvanized frame.

Table I—Savings Effected by Welding Kettle Ears

Fastening Kettle Ears by Riveting	
Punching	$0.68
Riveting	1.53
Soldering over rivets	.68
Total labor	$2.89
Rivets	.50
Solder	.30
Total labor and material	$3.79
Number of ears riveted	576
Fastening Kettle Ears by Welding	
Labor	$1.20
Number of ears welded	576

The savings effected by welding can best be illustrated by citing a few examples of typical jobs. In fastening kettle ears on buckets, the former method was to rivet them on, covering the heads with solder. Spot welding is much quicker and the cost is only 32 per cent of the cost of the riveting. A detailed statement of the cost of doing this work is given in Table I.

Table II—Welding Compared with Other Tin Shop Methods

Name of part	Cost by former methods: Labor	Material	Total	Number made	Cost of welding	Number welded
Lamp chimney baskets	....	....	$10.56	100	$3.52	100
Sheet iron lamp shades	. ..	....	1.57	500	.85	500
Switch lamp lens bands	$20.00	$1.50	21.50	3,000	12.21	3,000
Stove pipe elbows	....	....	14.40	250	7.20	250
Ventilator screens	6.43	1.31	7.74	450	2.38	450
Split keys	52.00	10.00	62.00	20,000	30.32	20,000

Another typical operation to which spot welding has been applied is making the tops for water glass lamps. These were formerly soldered at a cost of $3.40 per thousand for labor and $.40 for material. The same quantity can be welded at a cost of $.85 for labor. On this job there is an additional saving in the material from which the parts are made. When solder was used it was necessary to make the tops of tin, but sheet iron can now be used. The cost of other typical parts are tabulated in Table II.

The manufacture of flat split keys is one of the principal jobs handled on the spot welder. To expedite the work a special attachment shown in Fig. 2 has been devised. The framework holds a stationary disc, the edge of which is set between the welding points. Above this disc is a movable disc with recesses around the edge, of the same size and shape as the end of the cotter. Above each of the recesses is a spring which holds the parts when they are placed in the slots. At each revolution of the cam shaft the disc is advanced the distance between the slots by a ratchet operated by an electrically controlled valve, thus bringing the two pieces making up the key into position between the electrodes. A contact is then made and the parts are welded after which the ratchet advances them one notch further. The welded cotter then passes over an opening in the stationary disc where a finger on a rod attached to a lever on

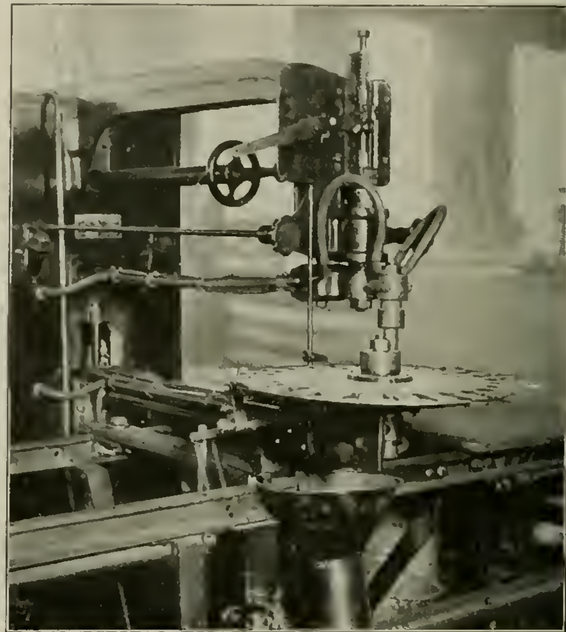


Fig. 2—Attachment for Welding Split Keys

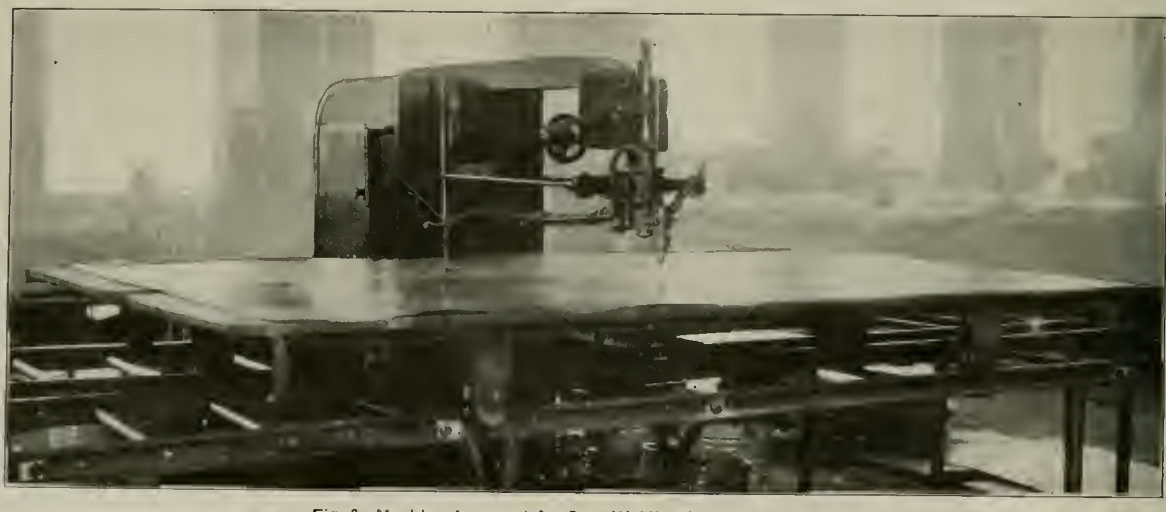


Fig. 3—Machine Arranged for Spot Welding Locomotive Jackets

the upper arm of the machine strikes it, causing it to drop into the receptacle beneath. The parts can be welded as fast as the operator can feed them. As many as 5,000 cotters have been made in seven hours.

Another important job for which special attachments have been made is the welding of locomotive jackets. The large sheets are placed on rolling tables as shown in Fig. 3 and are simply lapped and welded together along the edge at intervals of about ¾ in. to 1 in. The description of some of the typical parts made by spot welding as given above will serve to show the adaptability of this machine. Further developments are to be expected and devices of this type will probably become important adjuncts to railroad tinshops.

WHEN THE SEWING CIRCLE FAILED TO MAKE GOOD

BY HARVEY DE WITT WOLCOMB

Jim Haskins, the general foreman of the big shops of the Northwestern Railroad at Warren, was puzzled. Not alone puzzled, but disgusted also. He had just returned from his daily morning conference with the "Old Man," at which certain shop matters had been discussed and orders issued which Jim knew were contrary to the general policy of the shop. Heretofore the "Old Man" had always claimed that he did not care what the men or foremen did outside of shop hours; but this morning he had said that if big Bill Munson, the foreman of the boiler shop, did not cut out neglecting his family he would soon be looking for a new job. Bill Munson was a particularly good foreman, always on the job, a good mechanic himself and able to handle men. He actually obtained more work from two men than it was formerly possible to get from four men.

While Jim Haskins, as general foreman, worked with Bill practically every day in the week, he had never taken the trouble to look into his private family affairs and as long as the boiler shop was handled so efficiently, there was no need to investigate the man's home. Subconsciously, Jim Haskins felt that some one was trying to run Bill Munson off the job. By several remarks which the "Old Man" had made lately he knew there was a storm brewing. But why? Personally, he couldn't see one reason why Bill Munson wasn't the most valuable foreman they had. He had told the "Old Man" so, but he wouldn't have it that way. Jim had even quoted facts and figures to prove how much better Munson was than his predecessor, but to no avail. The "Old Man" had brought up little occurrences which Jim Haskins could remember when they were mentioned, but which had had no great weight on the management of the shop.

But now the "Old Man" was quoting these little things and placing so much emphasis on them that things actually looked bad for the boiler foreman. After Jim had left the office the thought suddenly struck him—where had the "Old Man" heard this stuff? Surely Munson had not said anything about his family affairs—Jim himself had not said anything about it—so where was the leak? To take such dirty, low-down, underhand methods to run a man off the job made Jim Haskins mad. He was a fair and just man himself. That was why he was so popular with all the shop men and was so successful as a shop manager. And he could not for the life of him understand why the "Old Man" would countenance any such doings.

Starting the day under these circumstances made Jim so disgruntled that he was on the war path all day. Try as he might, he could not get anything on the boiler department. Joe Kelly, the machine shop foreman, who Jim secretly knew was a wonderful man in the "Old Man's" estimation, but who was actually the poorest foreman he had, spoiled a driving axle, bored a set of driving boxes for the wrong wheels, nearly spoiled a new set of frames and was so careless that, driven to exasperation, Jim had to tell him frankly that if the machine department did not show a decided improvement it would soon have a new foreman. Under the conditions that morning I am not sure of all that Jim told the machine shop foreman, but he was in no mood to talk softly or mince his words, so you can wager that what he did say was forceful and to the point.

During the day many things came up which nearly drove Jim crazy, but he managed to pull through and was glad to go home where he could light his pipe and read his paper in peace.

As his wife was clearing off the supper dishes she remarked that the Munsons might move out of town. Being absorbed in his paper, Jim paid but slight attention to her remark and passed it by unnoticed. After finishing her work his wife brought out her mending and when Jim was refilling his pipe she remarked that Joe Kelly, the machine shop foreman, was talking about buying a home. Continuing she said: "Joe is a valuable man to the company and is sure of promotion and that is the only reason why he hesitates to purchase a home. He might just get nicely located and the company would move him to a better position."

"Yes, move him, but not to a better position if he don't mend his careless methods," grunted Jim. His wife noted that Jim was in no mood to talk, so the balance of the evening he was permitted to read his paper with no further interruptions.

The next morning as Jim started for the "Old Man's" office, he wondered what would be discussed. Engine failures were being held down to the minimum and the output was good. As he had had a good night's rest and the shop affairs were moving smoothly, Jim felt good natured. He even felt inclined to go in the boss's office, slap him on the shoulder and say, "Well, old timer, we've got them on the hip now. Everything is moving O. K."

But the minute he stuck his head inside the office door he could see trouble was brewing. The "Old Man" didn't waste any time, but started right in on Jim and bawled him out good and proper. To say that Jim Haskins was surprised is putting it mildly. He was dumbfounded! Since his appointment as general foreman at Warren he had doubled the shop output, had cut down engine failures, had reduced the pay roll, got along fine with the men and had carried on several improvements that were much to the advantage of the place, and now the "Old Man" was telling him what a poor stick he was. He told him all about his trouble with the machine shop foreman and informed him that the machine shop foreman was not responsible for such mistakes, but that he, the general foreman, was the one to blame. The "Old Man" even went so far as to say that the machine shop foreman would not be discharged, but if any such disgraceful recurrences came to his notice, the general foreman would have to do some explaining.

Can you imagine how Jim Haskins felt after a call-down like that? One day the "Old Man" wanted to discharge the best foreman on account of some trivial family affair and the next day he wouldn't allow the dismissal of a foreman who was the biggest failure in their organization. Poor Jim wondered who was stuffing the "Old Man" with all his misinformation. He tried to explain his position, but the "Old Man" would have none of it. Jim welcomed the opportunity to get out of the office when the chief clerk told him that something had just gone wrong with the turntable.

And again Jim's day was spoiled. He had started out in the morning well satisfied with conditions—in fact in fairly good humor, but the "Old Man's" talk had changed him into a frame of mind that was far from pleasant. He did not try to take any spite out on his foreman, but just the same he felt ugly enough to bite a ten-penny nail in two. He put in a most unpleasant day and was glad to escape to his home where he could eat his supper and enjoy a quiet smoke.

Again, as on the previous night, his wife ventured a remark that Joe Kelly had decided to buy that home. Subconsciously Jim felt that his wife had said something before about Joe Kelly. The Kellys were not neighbors of theirs, yet his wife seemed to mention their name a great many times. Puffing at his pipe like one of the big Mallets pushing a train up the hill, Jim reviewed in his mind all the occurrences of the past few days at the shop. Suddenly a thought struck him with such force that he yelled at his wife so loudly he nearly scared the poor woman out of a year's growth.

"Say," he said, "where do you hear so much about Joe Kelly, anyway?"

"Why, our sewing circle met this afternoon and while I was out in another room I overheard the master mechanic's wife telling how mean they used poor Joe Kelly at the shop. She said that it was a shame to pick on a good man like him and not to pay any attention to the disgraceful actions of a man like that Bill Munson. She also said that the Kellys were going to buy their home.

"By jimanetti," thought Jim, "I've got it! I've got it! It's that bunch of old hens who are trying to do poor Bill Munson. Some woman has an axe to grind and she is playing a smooth game." With that Jim began to question his wife and from her he could piece out a pretty good story of how this woman and that woman was working through her husband to try to influence the inside workings of the busy terminal at Warren. As Jim thought over the situation and recalled many little things which had been pulled off in the shops he could see the propaganda of the busy and ever watchful ladies' sewing circle. The master mechanic's wife was a prominent member. She was just foxy enough to work on her husband so that she influenced many of the orders he issued.

After turning the entire situation over in his mind several times Jim finally decided that the best way to fight fire was with fire.

The next morning he had a long talk with Bill Munson. During their conference they had several good laughs, and while Bill at first refused to follow Jim's instructions, he finally gave in.

Well, to make a long story short, Bill Munson's wife joined the sewing circle. She became a very prominent member and worked her way into the good graces of the master mechanic's wife.

Jim Haskins noted that the complaints about the boiler department seemed fewer and fewer. About two months after Jim Haskins awoke to the fact that wives play an important part in the management of a shop. He was agreeably surprised one morning by having the master mechanic remark that the boiler department was so efficient that he had recommended an increase for the foreman, Bill Munson.

Right there Jim Haskins smiled to himself, for he knew that instead of running a good man off the job, the sewing circle had actually been the means of securing him an increase in wages.

Increase in Coal Production.—Bituminous coal production in the United States during 1918, as reported by the National Coal Association, amounted to 587,500,000 tons, an increase of approximately 36,000,000 tons, or nearly seven per cent, over the production in 1917, which was in itself a record.

A CONVENIENT STAND FOR AIR PUMPS

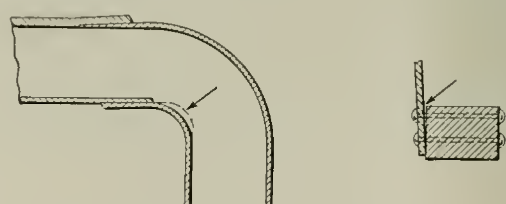
In overhauling air pumps it is desirable to have them mounted so that the cylinders can be placed either vertical or horizontal as desired. The stand shown in the illustration below, which has been in use for some time in the Joliet shops of the Elgin, Joliet & Eastern, makes it easy to bring the pump into any position. The stand is supported by a heavy post bolted to the floor. Near the top of this post is pivoted a disc made up of two plates riveted together to obtain the required stiffness. Behind the bottom of the disc and attached to the post are rollers which help to support the plate and make it easy to turn. There is also a cross piece attached to the post with a pin in the cross piece fitting into holes in the rear plate, thus holding it securely in any position. This stand is particularly suitable for cross compound pumps.

A Stand Used for Holding Air Pumps When Making Repairs

MAKING MUDRING CORNERS TIGHT

BY JOSEPH SMITH

No one knows better than the roundhouse man what a hot, dirty job is occasioned when an engine is reported with the back mudring corners leaking. Not only this, but many times it means a serious delay in engine service. By carefully noting the reasons for this condition we have come to the conclusion that 95 per cent of the troubles are due to



Imperfect Fit at the Mud-Ring Corners

the fact that, as shown in the illustration, there is a space of ¼ in. to ⅜ in. between the sheet and the top of the mudring. Cracks frequently occur in the sheet around the corners at the top row of rivets, and while welding them will help for a little while, it is finally necessary to cut out the sheet and weld a new piece in. This trouble could be eliminated if, when fitting the firebox to the mudring, the corners were well heated and set up tight before riveting.

Machining Locomotive Driving Boxes

Time and Effort Will Be Saved by Doing Accurate Work; Special Devices and Tools That Will Assist

BY M. H. WILLIAMS

The machining of locomotive driving boxes is quite an item in railway shops, and on account of the number that must be repaired the question of special machines and appliances for this work should receive special attention. It will often be found economical to install a special machine for these parts and use it exclusively on this work. On some machines the driving box shell may be bored, the hub liner faced and the oil cellar bored to the radius of the axles at the rate of three an hour, or 24 in an eight-hour day, an output equal to the demands of many of the larger repair shops. This will be found to be a greater output than is generally obtained on what may be called universal machines. As the driving box job has come to stay, it certainly should pay to install the very latest machine tools for the purpose of handling the work. One special machine for this work will in many cases release two machines, such as vertical or horizontal boring mills, for other work.

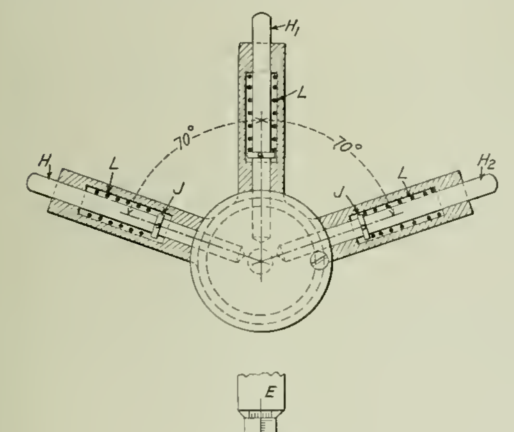


Fig. 1—Three Prong Micrometer Caliper for Measuring the Driving Box Bore

Accurate machining will also be found to be a paying proposition on these parts for the reason that when machined to proper sizes the work of assembling on the axle and locomotive will be reduced and an all-around saving will result. With a few special appliances, which will be described, the shells in the boxes may be bored, the sides faced and the cellar bored so accurately that individual fitting of the axle by filing or scraping may be entirely eliminated and better fits be obtained than with the general practice of scraping and filing. Several methods may be followed when performing this work. Those explained below have been taken from practices in several shops and will serve to illustrate various ways this work may be done.

First, it may be well to mention a few special appliances that may be used to good advantage in obtaining accuracy and reducing time.

Press for Applying Shell.—One of the first machine tools required is a press for removing and applying the shells. For this purpose the ordinary vertical hydraulic press answers very well and needs no explanation to railway shop men. In many respects it is advisable to equip this or any other form of press with a recording gage in order to produce a record of the pressure exerted when applying the shells. This, no doubt, may look like a refinement. However, a few points should be kept in mind. If the shell is forced in at too great a pressure the box will be spread apart and throw the shoe and wedge faces out of line. On the other hand, too low a pressure may result in the shells becoming loose. If a record of the pressure applied is kept it will soon be possible to determine a proper limit to be followed. The workman can also by observing the records, judge as to his work of fitting the shell and be governed accordingly when fitting future boxes. Records of this nature will be of interest to the shop manager and should be filed to be used in case of controversy. In many respects it will be found advisable to assign one press for applying shells, various side rod bearings and link motion bushings and equip it with a gage, using a second press for removing these parts. On account of the great pressure often necessary to start a shell, side rod brass or link motion bushing, a gage, if used on a press common to all work, will soon be in bad condition, due to the great pressure necessary to start a part loose.

MEASURING BORE OF SHELLS AND BOXES.

Measuring the bore of the brass or bronze shells and also the slotted half-round surface in the driver box for the shell bearing is very important, but difficult on boxes where these surfaces are less than a half circle and where the ordinary calipers cannot be used. A three-prong micrometer caliper has been used for this purpose, which answers very well, this being shown in Fig. 1. This is made up of an accurately ground steel cylinder *A*, having walls about ⅛ in. thick and the hole about 1 9/16 in. in diameter, a cap *B* at the lower end to resist the spring *S* and also to exclude dirt, and an upper cap *C* carefully threaded to fit the top of *A*. Adjustments of the caliper are made by this head and when it is properly set it is locked by the set screw *D*. A micrometer head *E*, such as may be obtained from several makers of these instruments is secured to the cap *C* by means of a nut *K*, fitting on a thread cut on the micrometer. This micrometer head is graduated for inside measurements or in opposition to the ordinary micrometer; that is, the readings are the smallest when the barrel is backed all the way up; as the barrel is screwed down, the readings become larger. The end of the micrometer screw bears on a hardened and ground plunger *G*, which fits very accurately into case *A*. The bottom of this plunger is accurately ground to a taper of six inches in twelve inches. The spring *S* forces the plunger *G* upwards against the micrometer head and takes up lost motion. Three rods, H, H_1, and H_2 fit into projections that are a part of case *A*. These rods are made of steel wire about ¼ in. in diameter, and are carefully hardened and ground, all three to exactly one length. The outer ends are slightly rounded, very similar to measuring rods used with micrometer calipers, the inner ends having points agreeing with the taper of the plunger. These rods are forced toward the center by springs, *L*, bearing against the frame and collars *J*. The three projections on the case are spaced at an angle of 70 deg. The rod H, H_1 and H_2 are of suitable lengths for shells and boxes to be measured. For measuring from seven to eight inches these are approximately 3¼ in. long. For each larger or smaller size the length will be increased or decreased by ½ in. Several sets of these rods may be used in one case where it will be necessary to change the rods when making measurements varying over one inch and will answer for small shops. Separate cases may be made for each size, which will avoid changing the rods.

For the purpose of setting this instrument, caliper rings carefully ground on the inside to even inch sizes are used. When setting the caliper the top cap *C* is adjusted up or down until the micrometer head registers zero, with all three rods in contact with the inner surface of the setting rings. After this the screw *D* is tightened to prevent the head cap *C* from turning.

In operation the plunger *G* is controlled by the micrometer head and opposed by spring *S*. The plunger *G* in turn controls the rods H, H_1 and H_2. It is obvious, on account of the angle on the plunger being six inches in twelve inches, that the rods will be forced out one-half the travel of plunger *G* and as the rods measure the radius, the reading on the

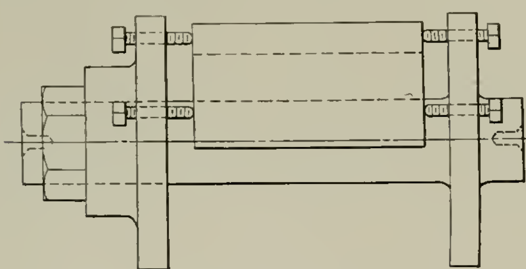


Fig. 2—Arbor for Turning Driving Box Brasses on a Lathe

micrometer head will show the actual diameter. When measuring the diameter of the bore of a shell or the slotted inner surface of the driving box, the micrometer head is screwed up or down until all three rods are in contact. No difficulty is experienced in determining this. If set too large the two outside rods H and H_2 only will be in contact, and by giving the caliper a slight rocking motion so that middle rod H_1 rises and falls, it will be noticed that the center rod is not in contact. Or if set too small the middle and only one side rod will touch, and by giving the caliper a slight right and left hand turn a very minute space may be detected. In practice a box or shell may be measured in a few seconds and to an accuracy of the thickness of a sheet of paper. This device is very valuable for measuring the bore of shells, and also to prove the accuracy of boring mills. With the best mills there is always the possibility of the boring head not being perpendicular to the mill table, causing the shell to be bored larger at one end.

Several different methods are followed for measuring the bore of boxes and shells. It is a question if any are more accurate or handy than using the three-pronged micrometer described. One of its greatest advantages is the fact that the machine operator can check his work and tell when it is correct, both for size and the straightness of boring. As the accuracy of boring is increased the labor of fitting the box

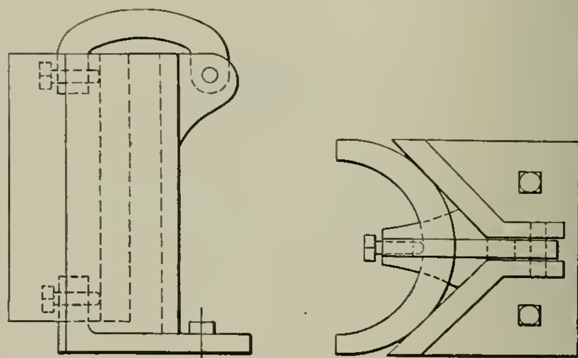


Fig. 3—Jig for Holding Driving Box Brasses When Machining the Ends on a Slotter

to the axle will be reduced. To properly make use of this device the axle should also be measured with micrometers.

MACHINING SHELLS.

For machining the outside surface of the brass shells several methods are employed, one being to clamp the shells to the table of a vertical slotter and revolve the table as the surface is being finished. This method is quite satisfactory. It, however, requires a somewhat expensive machine tool, compared with other methods. Another way is to hold the shell on a revolving arbor on a shaper table. In this case the arbor is revolved by a worm gear and wheel and generally operated by hand. This method works very well and does not require as expensive a machine as the slotter. In many respects the simplest and quickest method is to turn the shell on a lathe. For this purpose an arbor, as shown in Fig. 2, answers very well. This is made up of a heavy central bar about four inches in diameter, having a collar at one end forged solid with the arbor, as shown at *A*. On this arbor a loose collar *B* is fitted fairly snug. This is also keyed to a spline way cut in the arbor. The collar *B* is backed up by a large nut *C*, this nut being necessary to compensate for varying lengths of shells and may also be used for tightening the collar *B* on to the shell. The set screws *D-D* are used for tightening and holding the shells and are preferably made with cup points. In practice the shell is placed on the arbor and the set screws *D* drawn up enough to just hold the shell. The shell is then adjusted to the proper distance from the center of the arbor by a hammer. When properly set the three set screws in each collar are tightened. The method of setting the shells may be modified by placing a liner of wood or metal between the arbor and shell. This will locate the shell at once. It, however, requires a separate liner for each pattern of shell. In some cases these arbors are made double, so that two shells may be turned at one time on a lathe having two tool posts. This method increases the output of shells very materially and makes it possible to turn a pair of shells in less than 45 minutes, floor to floor. The diameter of the shells can generally be measured with calipers, as the castings in the rough are more than a half circle. In many respects a micrometer can be used to good advantage for this work, especially in conjunction with the three-prong caliper previously described.

For machining the ends of the shells several methods are employed, depending largely on the machine tool equipment available. One method is to hold the shells in a V-block set vertical on a slotter table, as shown in Fig. 3. This is made up of an iron casting *A*, which is bolted to the slotter table, and has a projection for a set screw *B* at the bottom and a hinged clamp *C* that may be thrown back when necessary to remove the shell. In practice the shell is placed with its machined surface against the *V* faces. The clamp *C* is brought over and the bolts *B* and *D* tightened.

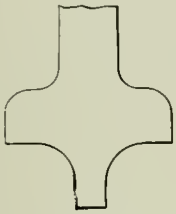


Fig. 4—A Shaper Tool for Machining the Ends of Driving Box Brasses

Another plan is to hold these shells by means of a similar clamp on the table of a shaper, in which event the fixture and the shell are in a horizontal position. This method is applicable to the ordinary or draw-cut shaper. A slotter or shaper tool, as shown in Fig. 4, can be used to good advantage for this operation. The end of the tool is used to remove the scale on the casting, the final forming being done with the formed part of the cutting tool.

Another method is to mill these ends on a plain knee type milling machine with a cutter formed to the contour of the desired end of shell. For new locomotives, where the shells are similar, two milling cutters may be used at one time.

For the average repair work the shaper will generally be found the most desirable, and is a less expensive machine tool than the others mentioned.

REPAIRS TO DRIVING BOX SHELL SURFACE

Machining the half-round surface in the driver box into which the shell fits is not necessary where the original work has been well done and the box has not been warped or sprained in service. On account of the enormous axle pressure of heavy locomotives it is very desirable that the shell have a perfect bearing in the driving box in order that the box may properly support the shell. It is, therefore, very desirable to check the shell bearing in the boxes after the shell is removed, and should there be a great variation in the radius of this surface the box should be reslotted. Just how much variation can be allowed is an open question. However, it is desirable to err on the side of safety, and it is a question if new shells should be applied where this surface varies over 1/32 in. or .032 in. from end to end. Should the variation be greater, reslotting is advisable. This variation may readily be measured with the three-prong micrometer. The actual machining of the boxes will naturally in most shops be done by the same methods prevailing for new work, of which the following may be mentioned.

Draw-cut Shaper.—This machine is provided with an arrangement in the ram for gradually revolving the cutting tool. In practice the box is held on the shaper table properly centered with the ram. After all is ready the cutting tool is set to the proper radius. As the machine makes a stroke the tool is rotated a small amount and so on until the work is completed.

Vertical Slotting.—This method is similar to the above except that the box is revolved instead of the tool. Either method admits of good workmanship when the machines are in a good state of repair. There is, however, always the possibility of the ram not being square with the work and machining one end of the box larger than the opposite end. To guard against trouble of this nature the boxes should be checked occasionally. This may be done with the three-prong calipers in Fig. 1. After the boxes are reslotted, or if it is not necessary to do this, the actual sizes of the box may be measured and a memorandum made of the actual sizes for the benefit of the workman turning the shell.

BOX FACE LINERS

For applying and machining the liners on the box faces several methods are followed both for brass and babbitt metal. When applying babbitt in some cases the practice is followed of pouring the babbitt the exact thickness desired.

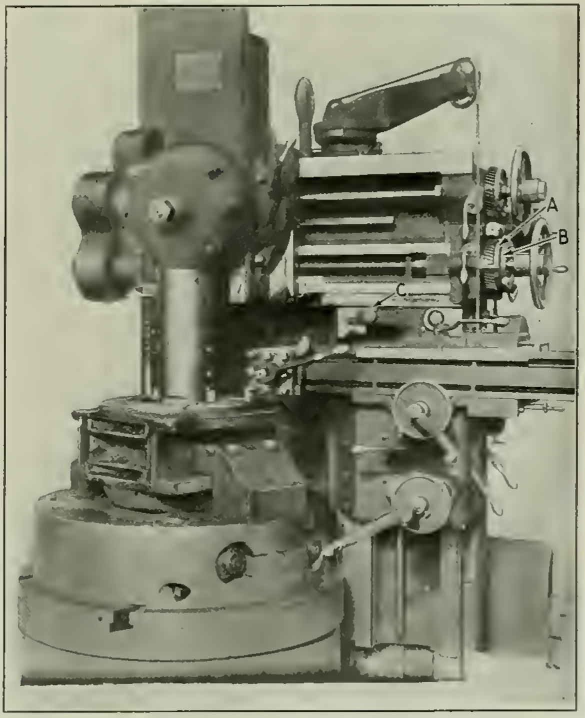


Fig. 5—Vertical Turret Lathe for Boring Driving Boxes

This is accomplished by locating a plate of boiler steel or cast iron the correct distance from the box and pouring the metal between the two. Where care is taken to locate the plate properly an excellent job may be made. A second method is to cast the babbitt somewhat thicker than necessary, which can be done by pouring from a ladle and without the use of a plate or other means of regulating the thickness of the babbitt. In this case it is necessary to machine the babbitt to the correct size. Where brass or bronze liners are used two methods may be followed, the use of either being governed largely by the design of the box on each particular road. In some cases the liners are faced on one side and secured to the box by flat-headed screws. In other cases the brass or bronze is cast onto the box. In either event, the liners are generally faced after applying.

In many respects the method of pouring these liners in the rough of either babbitt or bronze and facing them afterward will be found the more economical where proper machine tools are available for the purpose.

BORING AND FACING DRIVING BOXES.

For boring the shells and facing the liner several methods are followed, generally governed by the tool equipment available. The following methods are mentioned, which, however, do not cover the entire field.

Side Rod Boring Mills.—With this method the box is clamped on the machine table, the cutter for boring the shell being held in the revolving spindle and adjusted properly for the diameter required. A large sweep tool may also be used to face the babbitt liner. This method may be followed where better adapted machines are not available. It has the disadvantage that bronze liners cannot well be faced without a special facing tool and the bore and facing cannot be done at one time. Drill presses of heavy pattern are also used very similar to the method explained above.

Horizontal boring mills are also used for this purpose, the operation being very similar to that explained above, except that the box is set on its side instead of flat. This machine has the advantage that the table may be adjusted quickly to center the box.

Vertical boring mills of various forms are also made use of and are generally found more convenient than the other machines mentioned, having the advantage that the boring bar or tool may be readily adjusted for varying sizes of bore and either babbitt or bronze liners may be faced with an ordinary cutting tool. In the majority of cases the box is clamped on the mill table by the ordinary methods of clamping parts on these machines, which consumes considerable time in order to properly center the box.

Modifications of car wheel boring machines are also used for this purpose, in which event an adjustable tool is held

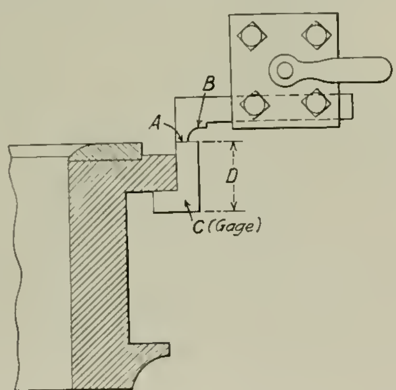


Fig. 6—Cutting Tool for Finishing Hub Liner Showing Use of Gages for Obtaining Proper Thickness

in the ram and the liner is faced by the facing attachments that are applied to these machines. Often special chucks are made to hold the box, with which it may be located and secured very quickly. This machine answers very well.

Vertical Turret Lathe.—For large and medium sized shops it will generally be found advisable to install a special vertical boring mill for boring and facing driving boxes and equip it with such chucks and special appliances as may be found desirable. At first glance this may appear extravagant. However, a careful review of the question will in many cases show that two or more machines are tied up on this work where one special machine will take care of the entire output. The so-called side head boring mill, or as sometimes called the vertical turret lathe, has been modified for this work. Fig. 5 shows a well known type of this machine fitted up specially for this work. As will be noticed on the illustration, the customary turret on the vertical ram has been replaced by a large single bar which is securely bolted to the seat for the turret. This bar, in order to secure rigidity, is made as large as possible, and on the machine illustrated it is seven inches in diameter and intended primarily for the larger driving boxes. For smaller boxes it would be necessary to reduce its diameter. At the lower end of this bar two cutting tools are held by set screws as shown. The tool at the right is used for roughing, and that at the left for the finishing cut. By always making use of one tool for the finishing cut the cutting edge will stand up for several

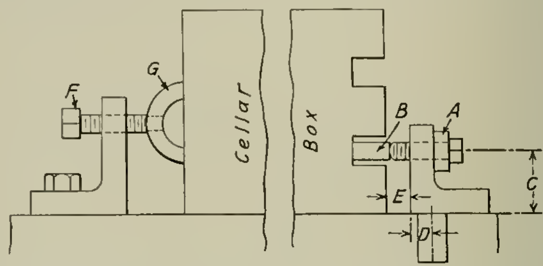


Fig. 7—Arrangement for Locating the Box with Respect to the Spring Saddle Pocket and for Holding the Cellar in Place While Boring

boxes and avoid too frequent settings of the tools. The hub liner is turned and the fillet formed by a specially formed cutting tool held in the side head, as shown in Fig. 5, and more in detail in Fig. 6. The facing of the liner is done with the cutting face *A* and the fillet by the concave cutting surface *B*.

In order to quickly locate the driving box a special two-jaw universal chuck, as shown quite clearly in Fig. 5, is used, the chuck jaws holding the box on the shoe and wedge surfaces, and as the two jaws tighten at a uniform rate, the box is located central with the center of the chuck. With this chuck it is unnecessary to measure the distances from the shoe faces to the center of the bore. The chuck is tightened by a square-headed screw clearly shown in the photograph. This screw operates two worm gears that are parts of the two right angle screws that close the jaws. The chuck is held on the table by T-bolts, the bottom surface of the chuck being keyed to fit the T-slots in the table. In practice these T-bolts are adjusted to allow free movement of the chuck on the table without lost motion. For readily adjusting the chuck to bore more or less from the crown of the brass an adjusting screw, not shown, is set in the mill table and works in a nut attached to the chuck, this screw being provided with a micrometer dial. By turning the screw, the chuck when holding the box may be set to run true or eccentric, as desired. This feature is valuable for reboring boxes having worn shells where only a small amount is to be removed to true up.

One feature incorporated on this machine that is worthy of mention is the method of setting the box with reference to the distance from the spring saddle pocket to the center of the bore of the shell. For boxes arranged for top saddle spring supports the boxes may all be set in the chuck the same distance from the saddle pocket to the center of bore, irrespective of the bore of the shell, without consuming any appreciable time in the set-up. A hole about two inches in diameter is bored in the chuck 13 in. from the center. A post, as shown in Fig. 7, fits into this hole. The post has a screw *A* with a large head, the point of which extends through the post a predetermined amount. The length of the screw and the distance *C* above the face of the chuck will vary with the different designs of boxes. The point of the screw *A* bears against the block *B*, which fits in the spring saddle pocket and which is of a definite thickness. The method of determining the use and size of each of these parts can best be explained by an example. Let it be assumed that the drawings call for a distance of 10 in. from the center of the bore of the driving box to the spring saddle pocket. As previously mentioned, the hole in the chuck is 13 in. from the center or three inches from the hole to the pocket. Suppose the dimension *D* is 1½ in. and dimension *E* is ½ in. In this case the block *B* must be one inch, giving a total of three inches. Other designs of boxes will call for modifications of these distances.

For the purpose of holding the cellar in the box while the boring operation is going on, a post, shown at the left in Fig. 7, is permanently bolted to the chuck face. This is provided with a bolt *F*, having a loose U-shaped shoe *G* attached to its point. After the driving box is clamped in the chuck the bolt *F* is screwed up to hold the cellar in place. The box will now be located so that the two shoe faces are an equal distance from the center of the chuck and from the center of the boring mill table. The cellar will be in place so that it may be bored with the shell, and the distance from the bore to the spring saddle pocket will be correct.

Very good use may be made of the micrometer dials on this form of machine, with which the time of calipering may be

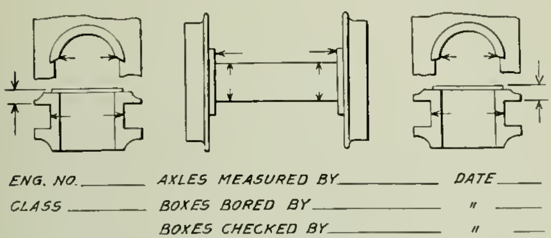


Fig. 8—Diagram for Recording Finished Dimensions for Driving Box Work

reduced to almost nothing. On the design in question two dials *A* and *B*, Fig. 5, are located on the cross screw. One of these dials is graduated right hand and the other left hand, each dial being independent of the other and arranged that they may be turned independently and clamped when properly set. The object of the two dials is to set one properly for the right hand or roughing tool in the boring bar, and the second for the left hand or finishing tool also set in the same bar, each dial being graduated to read to one-thousandth of an inch diameter. For the purpose of setting these dials a setting point *C* is arranged on the stationary part of the machine. In practice the boring bar is raised until the cutting tool is horizontal with the setting point and a pin bar of known length is set between the setting point and cutting tool. The cross screw is then turned until the pin bar just touches the setting point and cutting tool. The dial is then set with the zero mark to the pointer. The opposite cutting tool is then set in a similar manner with a *C*-gage. After setting the tools a trial cut is made on any box that may be on the machine, the bore measured and the dial given such slight corrections as may be necessary. With the dials once properly set any sized bore in the range of the machine may be made. That is, should it be necessary to bore a box 7, 7.5, 8, 8.070 or 9.120 in. the tools may be set by turning the cross screw until the dials read correctly and generally an accuracy of .005 in. will be obtained. It will readily be seen that a great amount of time may be saved by eliminating the calipering of each box as the boring operation is performed.

To insure facing the boxes correctly and to compensate for varying distances between the hub liners on the driving wheels and insure the correct amount of end play of the axles when assembled on the locomotive a very simple gage *C* may be used as shown in Fig. 6. This may be easily made from sheet steel about ⅛ in. thick. A separate gage is desirable for each class of driving box. The dimension *D* should be equal to the distance from the shoe space to the top of the liner on the driving box for a standard driving box made according to drawings and where proper allowances have been made for end play of axles.

This gage may be used in the following manner: Assuming that the distance between the hub liners is correct and the locomotive frame is also correct, the gage is held as shown in Fig. 6, and the cutting tool, held in the side head of the machine, is adjusted until it just touches the gage. The micrometer dial on the side head is then set to zero. This operation is repeated on the opposite side and should the two sides be nearly alike the average of the two may be taken. Should these two readings differ largely it may be necessary to plane the box in order that both shoe faces may bear equally on the shoes.

The liner may be faced by taking a roughing cut with the tool raised a small amount and the finishing cut with the micrometer dial back to zero. Should the distance between the hub liners on driving wheels be more or less than standard dimensions the tool is adjusted similar to that explained above, but when facing, the tool is raised or lowered the proper amount, which will be shown by the readings on the micrometer dial. For example, suppose the distance between the two hub liners is ⅛ in. above standard, owing to wear and refacing. This distance should be divided equally between the two driving box faces. In this event the facing tool would be raised one-half of ⅛ in. or .062 in. above the original setting. This amount may readily be ascertained by readings on the micrometer dial. Should the distance between the driving wheel liners be less the process would be reversed. This is a very simple operation and will be quickly understood by the machine operator.

MEASURING AND RECORDING SIZES.

For obtaining the correct size for boring the driving box shells the ordinary micrometer can be used to good advantage when measuring the axles. It will be found in practice that they are quicker to use than machinist's calipers and much more accurate, their great advantage being in the fact that the size measured may be recorded on a blank, as will be explained later. These micrometers are very useful for checking the axle for roundness and taper.

For measuring the distance between the hub liner faces on driving wheels the inside tubular micrometer may be used to good advantage. This measurement is essential in order to determine the correct amount the driving box liner should be faced to allow the proper amount of end play of driving wheels. It is advisable to bore the shell somewhat larger than the largest part of an axle worn taper or a new correctly turned axle. No well established rule appears to be followed for this amount. As a general proposition, if the box is bored from .015 to .025 in. larger than the axle the conditions of running will be found satisfactory.

Fig. 8 shows a form of card that may be used to good advantage for recording the desired finished dimensions for driving box work.

Rolling Stock for Danish Railways.—The Danish State Railways for a long time have been in need of more freight cars and recently ordered 750 from the "Scandia" factory in Randers, Denmark. This will give work to 500 people who have been unemployed. A set of wheels for a freight car before the war cost $40, while now they cost $348.—*Commerce Reports.*

SAFETY PRECAUTIONS FOR HANDLING OXY-ACETYLENE APPARATUS*

BY E. WANAMAKER
Electrical Engineer, Rock Island Lines

Unabsorbed acetylene, that is, in a gaseous state as generated, is highly explosive at a pressure of two atmospheres or more due to the chemical instability of the gas itself. Acetylene is more or less unstable and liable to sudden explosive decomposition under certain circumstances. Accidents sometimes occur when it is apparently impossible to guess what precipitated the decomposition which resulted in the explosion. Acetylene gas at ordinary atmospheric pressure and temperature does not fly apart spontaneously and explosively into its constituents, but does so when exposed to considerable pressure while in a wholly gaseous condition as previously stated.

It has been ascertained that acetone has the property of being able to absorb about 25 times its volume of acetylene for each atmosphere of pressure at 60 deg. F. When acetylene is dissolved in this way it ceases to be spontaneously explosive and may be stored with acetone at pressures up to 250 lb. with comparative safety. Persons not fully acquainted with the properties of acetylene gas should under no conditions be permitted to undertake the compression of it.

Acetylene gas is comparatively non-poisonous when inhaled in highly diluted form in small quantities such as might escape from small leaks: the only poisonous effects that have been observed in connection with it were due to the presence of impurities in the gas, such as phosphoretted hydrogen. Therefore acetylene should always be secured as free as possible from phosphorous and other contaminating substances.

It has been found that one pound of carbide will generate 46 cu. ft. of acetylene gas, which if permitted to leak into a room six by six by five feet, will mix with the air in such a proportion as to make it an inflammable explosive that may be set off by a spark as well as by a hot iron or flame. For this reason it is always well when using an acetylene torch in a small enclosed space to see that a sufficient quantity of air is obtained to prevent accidents from such a cause. A little air blowing from an air hose will prevent any such accident as this even though considerable acetylene were leaking into the space.

Oxygen is manufactured directly as a chemical product or electrolytically from water. Oxygen itself as a gas is non-explosive. However, it is generally stored in metal containers at a very high pressure, generally about 1,800 lb. per sq. in. It is therefore apparent that an explosion may take place due to the failure of the container itself permitting the gas to rush out at an enormous velocity.

It has been found at times when oxygen was made electrolytically, that due to the crowding of the pressure or careless handling a small percentage of hydrogen was permitted to mix with the product. Certain proportions of this mixture are highly explosive and may be set off by heat or jar. It is therefore necessary that oxygen be pure.

The following instructions for handling oxy-acetylene gas are strongly recommended:

In handling acetylene gas in tanks under pressure it should be remembered that at no time should the tank be allowed to remain near stoves, furnaces, steam radiators or any other sources of heat nor should they be exposed unnecessarily to the direct rays of the sun. Care should also be used in handling acetylene gas containers to avoid heavy jars. It must be remembered that any steel drum is liable to mechanical injuries if not reasonably handled. Acetylene cylinders should always be stored in an upright position with the valve end up.

*Abstract of a paper read before the Railway Fire Protection Association on December 4.

Leaking containers should never be used and should one be found, it should be set out in the open air as soon as possible away from all possibility of ignition of the gas or of the mixture of gas and air that surrounds the container.

Open flame lights should never be taken into confined spaces where there is any possibility of leakage of acetylene. In case it is found necessary to use an acetylene tank in a small enclosed space a little air should be blown into the space from an air hose in order to secure a good circulation of the atmosphere.

All acetylene containers should have fusible plugs.

Neither oxygen nor acetylene containers should ever be allowed to remain where they are exposed to sparks or flame.

Oxygen containers should not be dropped nor handled roughly in any way and should not be placed where they may be overturned by a collision with other objects or by reaction caused by the violent escape of their contents through the safety outlet with which containers should be provided.

The regulating devices, valves and other attachments on oxygen containers should never be lubricated with oil or grease. Whenever lubrication is required it should be secured by the use of pure graphite unmixed with either oil or grease. Furthermore the discharge valves of oxygen tanks should always be opened slowly and care should be taken to avoid twisting or straining them by the use of hammers or improper wrenches.

The hose and hose connections used between the gas manifolds or gas tanks and the welding torch must always be maintained free from leaks and all joints made mechanically tight and secure. The regulating valves and torches must be kept in a good state of mechanical repair to avoid leakage of the gases. No part of the equipment to which hose is attached should be used without securing the hose with the proper size hose clamp. Wire fastenings should not be used in any case.

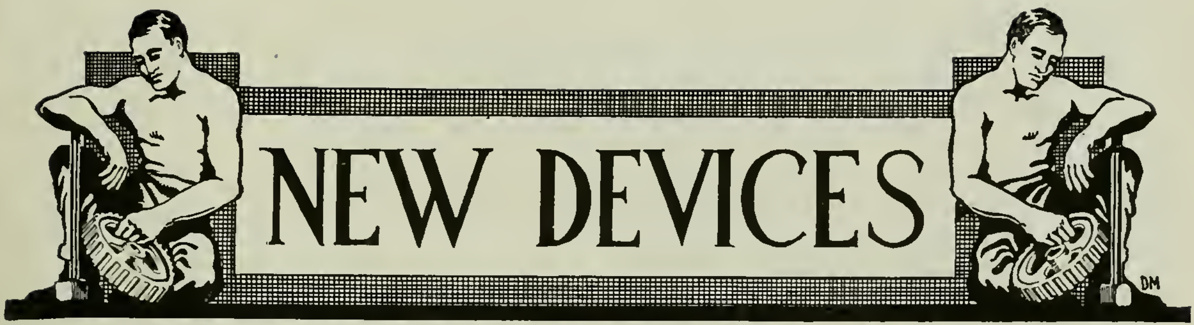
In case of any trouble with the torch the gas should be immediately shut off at the tanks or pipe line station.

Where generating stations are used the instruction cards sent with the parts must be carefully followed and no leaks must be permitted on any of the pipe lines.

No man should be permitted to use the gas welding torch until properly instructed by a welding supervisor or some experienced welder and if he is not the regular operator permission of the foreman in charge should be obtained before the machines are used.

Safety gages should be used on all regulators, that is, gages having loose or vented backs, so that in case the pressure on the gage builds up to a dangerous degree or builds up too rapidly, such as might cause a rupture of the Bourdon tube the force will spend itself without breaking the glass case, thereby causing possible injury to the operator.

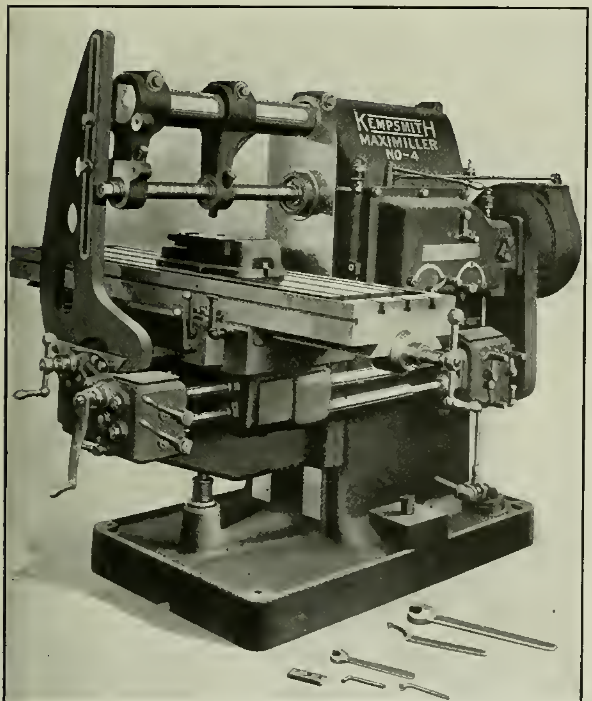
Some shops use portable welding outfits, purchasing tanked gas and tanked oxygen. Other shops install acetylene generating outfits, also oxygen generating outfits, piping the gas throughout the shops having manifold outlets to which the hose from the welding torches are connected. Still other shops generate acetylene gas and purchase tanked oxygen, connecting it to a manifold which in turn is connected with a system of piping in much the same manner as the oxygen generating plant. Each generating plant that is installed is equipped with a complete set of instructions for intelligently operating the generator, the most important of which are: "Remember to keep all light or fire of any kind away from the plant and never permit the generator to remain more than five minutes unless the generating chamber is filled with water, even when it is not in use." If the instructions that we have given in this paper and the detailed instructions which are given out with the generators are carefully followed out and leaks of all kinds prevented in the distribution piping system of the installed plants, there will be practically no danger from fire.



KEMPSMITH MAXIMILLER

The Kempsmith Manufacturing Company, Milwaukee, Wis., one of the first machine tool builders to make an all geared type of milling machine, has produced a new design of knee type milling machine called the "Maximiller." In designing the machine particular attention has been paid to insuring ease of operation and control with rapid production and accurate work.

Special material has been used in this machine in order to secure the adequate strength without excessive weight.

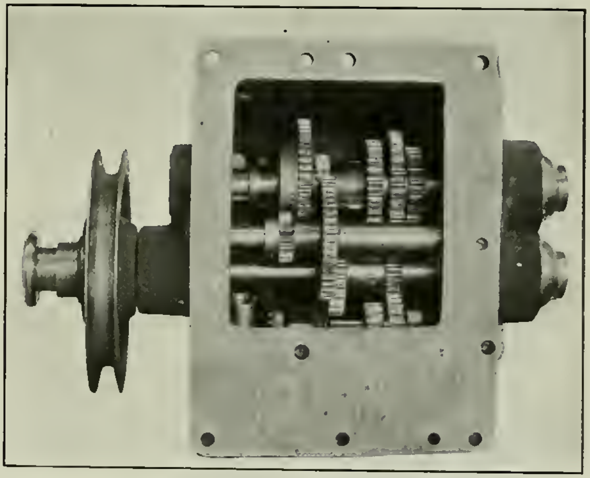


Heavy All-Geared Type Milling Machine

The spindle, gears and much of the shafting are made of heat-treated alloy steel. The column, knee, saddle and table are of semi-steel. The column is well ribbed and has few openings, and the knee is designed throughout to give the proper support to the saddle and table. The side walls are practically solid, having but two small openings, and the knee slide on the column is extended up beyond the top wall to provide extra resistance against strain. The top wall is solid, the cross feed screw being located in a shallow depression midway between the saddle Vees. The table is 18 in. wide with a working length of 72 in. The gibs in the saddle and table are of the adjustable taper type.

The over arm is a solid steel bar 5¼ in. in diameter, with a wedge lock which positively locates the pendants and alines the arbor, thus preventing any tendency to twist out of line under heavy cuts. The outboard support is of the open side type developed by this company, permitting free access to the table and the work at all times. It is reversible to bring the open space on either side as required.

The spindle is large in diameter and runs in adjustable phosphor bronze bearings. All other shafts in the speed transmission run on ball bearings. The driving force is applied to the spindle on a face gear which overhangs the front bearing, thus reducing the torsional strain in the spindle. As the face gear is the only slow speed member in



Feed Change Gears and Case, Showing Unit Construction

the driving train, chatter is practically eliminated and the drive is smooth under heavy cuts. The speed changes are secured through a train of gears giving 18 spindle speeds ranging from 14 to 350 r. p. m. All speed changes are secured by sliding gears and there are never more than three pairs of gears in mesh. The normal direction of spindle rotation is right hand which makes it correct for standard drills and boring tools. A spindle reverse has been incorporated in the machine, for, in order to get the cutting strains in the proper direction on the gibs and the tables, the face mills must run in the opposite direction from the spiral or slab millers.

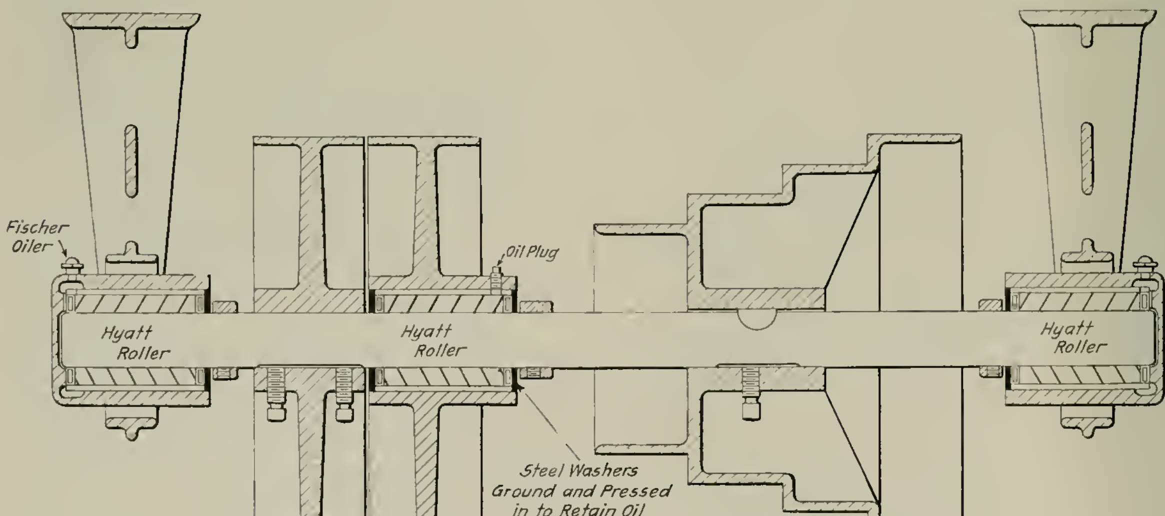
The principle of unit construction has been used to a considerable extent in the design, thus securing many advantages both in manufacturing and in repairing. The spindle speed change mechanism is an integral part mounted in a box secured to the column and the feed change mechanism is an independent unit mounted below the driving gear. There are 18 feeds available ranging from 5/8 in. to 25 in. per minute. Only one clutch is used and there are no tumblers or locking pins, all changes being obtained by sliding gears. All the speed changes are secured with only three levers and a direct reading feed plate makes it easy to obtain any combination desired. Incorporated in the feed mechanism is a safety coupling which slips before a breaking load comes on the feed drive but resumes the travel again as soon as the load drops to safe limits. The power rapid traverse can be used for all table movement without disturbing the set-up for whatever rate of feed may be in use.

A centrifugal type pump with a capacity of 15 gal. per minute is attached to an extension of the feed drive shaft to circulate cooling compound. The pump is driven through a clutch which can be disengaged if the nature of the work does not require a cooling fluid. The lubrication of the parts has been given special consideration in this machine. The gears and bearings in the speed and feed mechanisms are lubricated by splash from an oil bath in the case. Sight feed oilers are used to supply clean oil to the spindle bearings and drive pulley. The lubrication of the mechanism supported by the knee is centralized at two points which makes it certain that none will be overlooked when the machine is oiled.

The driving pulley is 16¾ in. in diameter and runs at 400 r. p. m., a six-inch belt being used. For general railroad shop work a 15-h.p. motor is recommended for driving this machine.

ROLLER BEARING COUNTERSHAFT

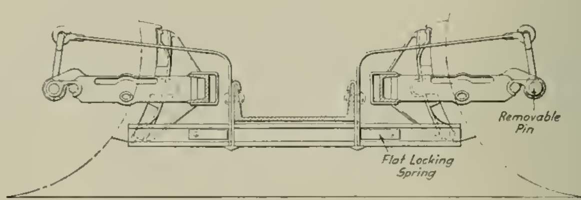
As a step in a program of refinement in its line of shapers, part of which has been carried into effect during the war, the Queen City Machine Tool Company, Cincinnati, Ohio, has designed a roller-bearing countershaft which will be included as part of the equipment of all shapers manufactured after March 1, 1919. As shown in the drawing, the countershaft hangers have been designed to include Hyatt roller bearings. The journal boxes are cast with the outer ends closed and the inner ends are closed with steel washers which are ground and pressed in to retain the lubricant. The loose pulley also runs on Hyatt rollers and both ends of this bearing are closed in the same manner as the inner ends of the journal boxes. The purpose of reducing the inefficiency with which power is transmitted from the line shaft to the machine has been carried out in a design the simplicity of which is intended to insure against any increase in the amount of inspection or attention required to keep it in satisfactory working order.



Roller Bearing Countershaft for Queen City Shapers

ATLAS SAFETY GUARD AND THIRD POINT SUPPORT

For some time past the American Steel Foundries, Chicago, has been manufacturing a safety device for brake beams known as the Atlas Safety Guard. This consists of a bar of I-Section fastened beneath the spring plank in such a position as it will support the brake beam in case the brake hanger should fail or the pins fall out. A further improvement has been made in this device by providing an additional support for the brake beam to insure even brake shoe wear. This is accomplished by extending arms upward and outward from the safety bar support on the spring plank and fastening the brake beams to these arms by short links. In cases where one safety bar is used on each truck, these links are attached to the end of the brake beam strut; when two safety bars are applied the links are fastened to the tension member. The safety bars, as in the previous design, are held in place by flat springs and can readily be slid through the supports under the spring plank when it is desired to remove the brake beam. The arm and links being above the beam, do not interfere with its removal in any way.



Atlas Safety Guard and Third Point Support

Railway Mechanical Engineer

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THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

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Exports of locomotives through the port of New York during December, 1918, amounted to $1,755,891, according to figures given in the monthly foreign trade records issued by the National City Bank. The report also shows rails exported to the value of $1,354,795 and car wheels and axles valued at $413,720. Freight cars are not separately shown in the tabulation.

The railways of India on March 31, 1914, had 170,444 freight cars. The number laid up for repairs at present is about 10,290, or about 6 per cent, of which 1,860, or about 1 per cent, of the total, were laid up for want of materials. The number is lower than in normal times, owing to the efforts the railways were making to keep every available freight car on the road. The number of cars sent overseas was 4,251, all of these except 56 were of metre or 2 ft. 6 in. gage.

The International Railway Congress has resumed its headquarters at Brussels with the return to that city of M. L. Weissenbruch, the general secretary. The Congress, before the war, held its meetings every five years, meeting in 1895 in London, 1900 in Paris, 1905 in Washington, 1910 in Berne, and the 1915 meeting was to have been held in Berlin. The Congress, before the war, also proved of service to railway men the world over by the publication at Brussels of a monthly bulletin.

The great scarcity of coal in Italy has made it necessary to use wood and lignites for fuel in locomotives. The boilers and fireboxes of the locomotives have had to be changed to suit the new fuel, and employees re-educated to a considerable extent. The use of substitutes for coal as fuel has been urged on all manufacturers, and prizes have been offered for noteworthy economies. In addition to that, two companies, with an initial capital of $1,200,000 each, have been formed for the development of lignite or brown-coal mines in Italy. One will operate mines in northern, the other in southern Italy.

The State Department at Washington has received through the American Legation at Brussels a request from the Belgium government asking the United States to lend it 400 locomotives and 2,000 cars in addition to returning all of the 359 locomotives which were placed at the disposal of the American Expeditionary forces. The communication from Minister of Railways Renkin, sets forth the urgent need for additional rolling stock in Belgium to replace that commandeered or destroyed by the Germans. The American army has returned 187 of the Belgian locomotives, but the remaining 172 still are in use by the Expeditionary forces.

Maximum prices on anthracite coal, together with all other coal and coke regulations except three, have been suspended by the Fuel Administration. The only restrictions not suspended, as to coke and all coal, are: Those requiring that contracts be made subject to maximum prices if reinstated, subject to cancellation by the Fuel Administration and subject to requisition or diversion of coal by the Fuel Administration. Those prohibiting reconsignments of coal. Those requiring shipments of coal to tidewater to go through the Tidewater Coal Exchange. The order includes the suspension of price and zone regulations on coke and bituminous coal which went into effect February 1. The administration's control of the oil industry already has been mostly suspended, so that the Fuel Administration's controls are now relaxed to the present limit of safety.

The Engineering Societies' Employment Bureau, New York City, desires that state and municipal authorities, corporations and individuals who need the services of professional engineers communicate their wants to the bureau, 33 West Thirty-ninth street. This bureau is maintained by the four national societies of civil, mining, mechanical and electrical engineers. In behalf of engineers who have been serving in the army or in government capacities during the war, it is the desire of the Engineering Societies to get in touch with contemplated engineering projects as early as practicable. By resolutions adopted unanimously (by the 650 members present at its annual meeting) the American Society of Civil Engineers has recorded "its profound conviction that public works should be carried forward to the fullest extent consistent with sound judgment, not only for fundamental economic reasons, but for humanitarian reasons."

Two new Safe Practices Bulletins of the National Safety Council have been published. No. 16 is a ten-page illustrated monograph on safe clothing for men and women in industry. These excellent brochures contain a large amount of useful information, gathered from varied sources and clothed in lucid and vigorous language. Some members of the Council, to encourage the wearing of suitable clothes, provide women employees with the first suit free of charge. Bulletin No. 18 is on Power Presses. The ingenious recent devices for preventing workmen from injuring their hands or feet in these ponderous machines are innumerable. One picture shows a large press, in a shop of the Ford Motor Company, where each of two men must press an electric push button with each hand before the machine can be operated. These pamphlets are provided at a cost of ten cents each by the National Safety Council. 208 South La Salle street, Chicago.

Future of Gas and Electric Welding

At a joint meeting of the American Institute of Electrical Engineers and American Institute of Mining Engineers, on February 19, five papers were presented on the subject of welding, as follows: "Microstructure of Iron Deposited by Electric Arc Welding," by G. F. Comstock; "Path of Rupture in Steel Fusion Welds," by S. W. Miller; "Welding Mild Steel," by H. M. Hobart; "Electric Welding in Shipbuilding," by S. V. Goodall, and "Fusion in Arc Welding" by O. H. Eschholz.

A lively discussion followed their presentation during which it was suggested that as so much had been done in the way of making repairs, particularly by the railroads during the past two years, the time was ripe for bringing the welding processes permanently into the field of construction. It was pointed out that there are many variables to be determined in order to secure a good weld and that successful welding is dependent upon uniformity of results. For this reason it was stated that the welding operator must be both skilled and conscientious, and a diversity of opinion was expressed in the discussion as to whether the operator should be a skilled engineer or whether the average worker could be taught to do good welding work.

The particular significance of the presentation of the papers and the discussion lies in the fact that welding is demanding so much of the attention of our best engineers. This in itself is sufficient indication that the constantly increasing use of welding is to be expected. Conclusions indicated by the discussion were that both gas and electric welding had come to stay and that we may prepare for the time when the average mechanic must learn the use of the welder, just as he has had to learn the use of the hammer and chisel.

The Disposition of Surplus Government Material

Announcement was made in Washington on January 29 giving the details of the plan of organization of the Office of Director of Sales of the War Department as follows:

Under the director of sales, C. W. Hare, is an assistant, E. C. Morse, chairman of the Board of Sales Review, comprising the following members besides Mr. Morse: Lt. Col. A. LaMar, Major W. M. Crunden, Col. Fred Glover, L. H. Hartman, G. F. Woods, Capt. A. L. Mercer, Capt. T. S. Schultz. Each of these members of the board is a division sales manager with the exception of Captain Schultz, who is legal member on the board.

The announcement gives the names of seven divisions, the first of which, headed by Colonel LaMar, will handle machine tools, including all metal and woodworking tools, railway equipment, steam shovels, locomotive cranes, gantry cranes, hand tools, forging equipment, iron and structural workers' power tools and machinery.

The following is the tentative agreement reached by the government and the machine tool builders.

"1. The inventory of all machine tools and equipment which is being made will be expedited to the greatest possible extent.

"2. As soon as it is known that a quantity of machine tools is available for disposal, the manufacturers of these tools will be given an opportunity to purchase them at a price and on terms of settlement which will be satisfactory to all parties concerned.

"3. In case it is impossible for the manufacturer to purchase his product outright, an effort will be made to arrange for the marketing of the product in an equitable manner, securing for the government and the manufacturer alike the best possible terms.

"4. In case both these methods of disposition fail, the material will be offered for sale to the general public in a manner prescribed by law.

"In the settlement of plant contracts which involve the sale of large groups of various kinds of tools and equipment, an effort will be made to prevent the sale of any equipment for resale, as it is realized that great injury could be done by indiscriminate sales of this character."

Railway Regiments' Tobacco Fund

The Railway Regiments' Tobacco Fund, to which 146 railway supply companies contributed, made seven shipments of tobacco, amounting to approximately eight tons, to railway regiments in service in France. Owing to the congestion in the transport service during the summer on account of the great number of troops going over, it was found that this tobacco was not being delivered to the regiments to which it was consigned, and shipments were therefore postponed until the transport service could be organized to the point where delivery was assured; but the movements of the various railway regiments were so uncertain that it was finally decided not to make any further shipments. The total amount subscribed to this fund was $16,129.94, of which $10,056.05 was spent for tobacco, leaving $6,073.89 still in the hands of the committee handling the fund. This sum is approximately 37.5 per cent of the amount subscribed, and the committee, in making arrangements for the closing of the fund, has decided to return to the contributors 37.5 per cent of each subscription received. This will amount to practically all the funds available, with the exception of a few dollars, which will be utilized to defray expenses. In requesting subscriptions it was specifically stated that they were only to be made up to the end of the year 1918, and accordingly, all checks received since December 31, 1918, are to be returned.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Mar. 11	Varnish	Norman Holland	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Mar. 14	Unified Inspection and Maintenance of Car Equipment	J. J. Tatum	Harry D. Vought	95 Liberty St., New York.
Cincinnati	May 13	Fuel Conservation	D. E. Dick	H. Boutet	101 Carew Building, Cincinnati, Ohio.
New England	Mar. 11	Annual Meeting and Entertainment, Election of Officers and Reports		W. E. Cade	683 Atlantic Ave., Boston, Mass.
New York	Mar. 21	Railway Supply Men's Night		Harry D. Vought	95 Liberty St., New York.
Pittsburgh	Mar. 28			J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	Mar. 14	Unification of Telegraph and Telephone Facilities	F. E. Bentley	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Mar. 17	Mechanical Stoking of Locomotives, by W. S. Bartholomew. Address by Lt. Comm. D. C. Buell on U. S. Naval Railway Batteries in France		A. F. Stuebing	750 Transportation Bldg., Chicago.

The Railway Regiments' Tobacco Fund was initiated by F. A. Poor, president of the P. & M. Company, Chicago, and in order to raise the necessary funds, a committee was organized composed of Mr. Poor, as chairman; R. P. Lamont, president of the American Steel Foundries; George A. Post, president of the Standard Coupler Company; E. H. Bell, president of the Railway Supply Company; J. M. Hopkins, president of the Camel Company, Chicago, and A. C. Moore, vice-president, Safety Car Heating & Lighting Company. Samuel O. Dunn, editor of the Railway Age, was secretary of the committee, and John R. Washburn, vice-president of the Continental Commercial Bank, Chicago, acted as treasurer of the fund.

MEETINGS AND CONVENTIONS

Railroad Club of Washington.—One hundred and twenty employees of the Railroad Administration in the city of Washington have organized the Railroad Club of Washington. W. C Kendall, manager of the Car Service Section of the Railroad Administration, was elected president.

American Steel Treaters' Society.—This association was recently formed for the announced purpose of promoting the arts and sciences connected with the heat treatment of steel. The principal means for this purpose is to be the holding of meetings for the reading and discussion of papers bearing upon processes, instruments, equipment, apparatus, etc., employed in practical and research work connected with the art, collection, publication, and dissemination of technical and practical knowledge for the improvement of conditions in connection therewith, and to closely unite those engaged in its practical and technical branches.

A monthly journal which brings the papers and discussions had at various meetings directly to the hands of every member is published. Comprehensive and valuable service features are also a growing part of the journal and of the society's activities. Sample copies and other information may be had by addressing the general office of the society, 154 East Erie street, Chicago.

In addition to meetings in Chicago, a chapter has been organized in Cleveland, and movements of this kind are now under way in several other large cities.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 6-8, 1919, Chicago.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, New York, N. Y.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention May 26-29, Hotel Sherman, Chicago.

MASTER CAR BUILDERS' ASSOCIATION.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 18-21, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C. Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

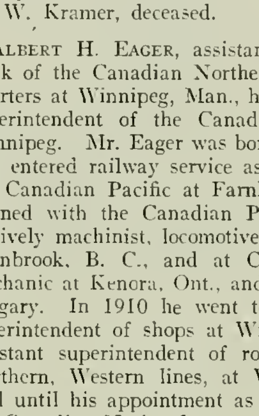
GENERAL

C. L. BUNCH, shop superintendent of the Southern Railroad, at Spencer (N. C.) shop, has been promoted to master mechanic of the Memphis division, with office at Sheffield, Ala., succeeding J. W. Gibbs, resigned.

J. L. CARVER has been appointed engineer of tests of the Illinois Central and the Yazoo & Mississippi Valley, with headquarters at the Burnside shops, Chicago, to succeed M. W. Kramer, deceased.

ALBERT H. EAGER, assistant superintendent of rolling stock of the Canadian Northern, Western lines, with headquarters at Winnipeg, Man., has been appointed mechanical superintendent of the Canadian National, with office at Winnipeg. Mr. Eager was born at Waterloo, Que., in 1868, and entered railway service as a machinist apprentice with the Canadian Pacific at Farnham, Que., in 1885. He remained with the Canadian Pacific until 1910, being successively machinist, locomotive foreman, general foreman at Cranbrook, B. C., and at Calgary, Alta, district master mechanic at Kenora, Ont., and again locomotive foreman at Calgary. In 1910 he went to the Canadian Northern as superintendent of shops at Winnipeg, and in 1915 became assistant superintendent of rolling stock of the Canadian Northern, Western lines, at Winnipeg, which position he held until his appointment as mechanical superintendent of the Canadian National.

WILLIAM F. KEISEL, JR., assistant mechanical engineer of the Pennsylvania Railroad, Eastern lines, has been appointed acting mechanical engineer, with office at Altoona, Pa., succeeding A. S. Vogt. Mr. Keisel was born on September 1, 1866, at Scranton, Pa., was educated in Lehigh Preparatory School, and in 1887 graduated from Lehigh University with the degree of mechanical engineer. He entered the service of the Pennsylvania Railroad as a draftsman, in the office of the mechanical engineer in April, 1888, and was promoted to chief draftsman in March, 1899. On July 1, 1900, he was appointed assistant engineer, and in September, 1902, he became assistant mechanical engineer, in which capacity he also had charge of the test department at Altoona until the separation of the two departments. Mr. Keisel's appointment as acting mechanical engineer of the Pennsylvania Railroad, Eastern lines, became effective on February 1.



W. F. Keisel, Jr.

T. J. LOWE, fuel agent of the Canadian Northern, Western lines, has been appointed fuel agent of the Canadian National, Western lines, with headquarters at Winnipeg, Man.

J. A. SUTTON, fuel and tie agent of the Transcontinental division of the Canadian Government Railways, has been appointed district fuel agent of divisions No. 1 and 2 of the Central district. Canadian National, Western lines, with headquarters at Cochrane, Ont.

H. Weitzel, master mechanic of the Arizona Eastern at Phoenix, Ariz., has been appointed trainmaster with office at Globe, Ariz., succeeding A. D. Rosecrans.

George W. Rink, mechanical engineer of the Central of New Jersey, has been appointed assistant superintendent of motive power, with office at Jersey City, N. J. Mr. Rink was born on September 4, 1875, at New York, and was graduated from Cooper Institute, New York City, with the degrees of B. S. and M. E. He began railway work on March 14, 1892, as a machinist apprentice on the Erie Railroad. From March, 1896, to March, 1899, he served as a machinist and shop draftsman, and then to September, 1900, as a draftsman on the Northern Pacific. He then entered the service of the Central of New Jersey, as a draftsman and from 1901 to 1902, was roundhouse foreman and inspector of new equipment. Later he was engaged in road testing of locomotives and as draftsman, until 1903, when he was promoted to chief draftsman. From April, 1904, to January, 1909, he was instructor of apprentices, and then was appointed mechanical engineer, which position he held until his recent appointment as assistant superintendent of motive power.

G. W. Rink

Axel S. Vogt, mechanical engineer of the Pennsylvania Railroad, Eastern lines, with office at Altoona, Pa., retired under the pension rules of the road on February 1. He was born on January 19, 1849, at Christianstad, Sweden, and was educated in the public schools. He began railway work in June, 1874, with the Pennsylvania Railroad at Altoona, and remained with that road until 1882, when he went with Schutte & Koehring, Philadelphia, Pa. In November, 1883, he returned to the service of the Pennsylvania Railroad as assistant engineer of tests. On March 1, 1887, he was promoted to mechanical engineer, and from that time until his retirement he served continuously in that capacity. The total length of his service with the Pennsylvania Railroad was a little more than 43 years, during which time freight and passenger cars passed through the transitory stage from wood to steel construction and locomotives increased in capacity fourfold and more, and the designs developed under Mr. Vogt's direction had considerable influence on their progress.

A. S. Vogt

Master Mechanics and Road Foremen of Engines

W. C. Barr has been appointed general roundhouse foreman of the Erie at Meadville, Pa., succeeding H. C. Eckardson, resigned.

W. E. Beck has been appointed road foreman of engines of the Erie Railroad with office at Meadville, Pa., succeeding Bert Hill, transferred.

James Carney has been appointed general foreman of the Erie Railroad at Newburgh, N. Y.

H. A. English, master mechanic of the Central district, Canadian Northern, has been appointed master mechanic of the Central district of the Canadian National, with headquarters at Winnipeg, Man.

R. E. Line has been appointed roundhouse foreman of the Erie Railroad at Kent, Ohio.

Andrew McCowan, supervisor of car works of the Canadian Northern system at Winnipeg, Man., was appointed master car builder of the Canadian National Railways, Western lines, with the same headquarters, at the time of the recent assimilation of the former road by the latter. Mr. McCowan was born at Perth, Scotland, on December 5, 1867, and was first employed by the Perthshire Carriage Works (Scotland), as an apprentice car builder, between 1881 and 1887. He began his railroad experience in May, 1888, as a carpenter on the Canadian Pacific at Montreal, Que. In March, 1890, he was promoted to car foreman, and seven years later he was appointed shop foreman at Farnham, Que. From September, 1903, to April, 1910, he was car foreman at Cranbrook, B. C., and on the latter date left the Canadian Pacific to become general car foreman of the Canadian Northern at Winnipeg, Man. He was promoted to supervisor of car works, Western lines, in September, 1915, and in May, 1916, had his jurisdiction extended over the entire system.

A. McCowan

H. G. Reid, assistant superintendent of rolling stock of the Canadian Government Railways at Transcona, Man., has been appointed general master mechanic of the Canadian National, Western lines, with offices at Winnipeg, Man.

L. G. Roblin, general master mechanic of the Canadian Government Railways, Western lines, with offices at Cochrane, Ont., has been appointed master mechanic of the Prairie district of the Canadian National, with offices at Saskatoon, Sask.

Purchasing and Storekeeping

A. E. Cox, general storekeeper of the Canadian Northern, Western lines, has been appointed general storekeeper of the Canadian National, Western lines, with headquarters at Winnipeg, Man.

W. D. Manchester, chief engineer of the Manistee & Northeastern, with office at Manistee, Mich., has been appointed purchasing agent to succeed E. H. O'Neil, who has resigned.

SUPPLY TRADE NOTES

J. H. Regan, assistant secretary of the Pressed Steel Car Company, has been transferred from the New York to the Chicago office of that company.

The eastern branch of the Independent Pneumatic Tool Company, Chicago, has been moved from 170 Broadway to larger quarters at 1463 Broadway, New York.

George N. VanSweringen, sales representative, has been appointed assistant to the vice-president of the Chicago Railway Equipment Company, with headquarters at Chicago.

On January 1 the Duntley-Dayton Company took over the entire output of the Dayton Pneumatic Tool Company, of Dayton, Ohio, and announced its entry into the pneumatic tool field. W. O. Duntley, former president of the Chicago Pneumatic Tool Company, is president of the new concern and his son, Capt. C. A. Duntley, is vice-president. Captain Duntley has not yet been relieved of his command in the 27th United States Field Artillery. The Dayton line of pneumatic tools has been on the market for many years. A new plant, equipped with modern machinery, has just been completed to take care of the business of the company.

W. O. Duntley

In addition to handling the output of the Dayton Pneumatic Tool Company, the Duntley organization is putting out a complete line of portable electric drills and grinders, as well as a full line of accessories, such as hose and hose couplings, rivet sets and chisel blanks. W. O. Duntley is one of the pioneers in the pneumatic tool business and has been closely connected with the industry for the past 25 years. He has a number of pneumatic and electric tool inventions to his credit, the Duntley electric drill being, perhaps, the most widely known. The offices of the Duntley-Dayton Company are located in the Westminster building, Chicago; the eastern offices are at 295 Fifth avenue, New York, and the Philadelphia branch in the Commercial Trust building.

Lieut.-Col. R. P. Lamont, division chief of ordnance department, with headquarters at Washington, resumed his duties as president of the American Steel Foundries at Chicago on February 1.

J. D. Corby has resigned as St. Louis district manager of sales for the Chicago Pneumatic Tool Company and has assumed the active management of the Corby Supply Company, of St. Louis.

W. R. Colklesser has been appointed purchasing agent of the Gadsden Car Works, Richmond, Va., succeeding W. F. H. Finke, resigned to accept service with the United States Railroad Administration.

Millard F. Cox, assistant superintendent of machinery of the Louisville & Nashville at Louisville, Ky., has become associated with the Louisville Fire Brick Works, Inc., of Louisville, as vice-president and consulting engineer.

William G. Denney, treasurer of the Standard Car Truck Company, Chicago, died on February 7, at his home in Millerton, N. Y., at the age of 65 years. Mr. Denney had been with the Standard Car Truck Company since its organization.

The Patterson Sargent Company, Cleveland, Ohio, is now represented by L. J. McComb as railroad paint and varnish salesman, with office at 201 Devonshire street, Boston, Mass. Mr. McComb succeeded F. Howard Childs, who died December 15, 1918.

W. W. Butler, vice-president of the Canadian Car & Foundry Company, Montreal, Que., has been appointed president. Mr. Butler is also president of the W. W. Butler Company, Ltd., and a director of the Page-Hersey Iron Tube & Lead Company.

Fred M. Egolf, who has been associated with the Acme Railway Supply Company and the Acme Steel Goods Company, has been appointed western railway and marine sales representative of the Glidden Company, Cleveland, Ohio, with headquarters in Chicago.

The Interstate Car Company, Indianapolis, Ind., is erecting a steel car and tank car repair shop and fabrication plant at Indianapolis, Ind. The building will be of structural steel, 83 ft. by 245 ft., and 40 ft. high, costing approximately $50,000. George J. Dive is in charge.

W. S. Quigley, president of the Quigley Furnace Specialties Company, Inc., New York, sailed for Liverpool on February 15, for the purpose of further developing European connections of his company. Mr. Quigley will spend several weeks in England, France and Italy, and visit the plants installing the Quigley system for preparing and burning pulverized coal and lignite.

Ezra S. Taylor, assistant to the vice-president of the Pullman Company, has been elected assistant to the president, with office in the Pullman building, Chicago. Mr. Taylor was born at Chicago in 1880. When 17 years old he entered the employ of the Atchison, Topeka & Santa Fe as a member of a surveying gang in Texas. After three years in this work, he came to the Chicago office of the Santa Fe as a clerk in the freight department, and in 1900 he entered the employ of the Pullman Company as a clerk in the auditing department. From 1902 to 1905 he was assistant to the storekeeper, and later to the operating superintendent of the Chicago Elevated Lines at Chicago. The following three years he was assistant purchasing agent for the Western Steel Car & Foundry Company, at Anniston, Ala., and later at the Hegewisch (Ill.) plant. To increase his knowledge of the steel business, Mr. Taylor subsequently entered the employ of the Illinois Steel Company at its open hearth plant in South Chicago, where he remained for one year. In 1909 he returned to the Pullman Company as chief clerk in the sales department, and was subsequently general eastern agent at New York and assistant to the vice-president, which position he held until his appointment as assistant to the president on February 6, 1919.

E. S. Taylor

W. W. Hayward, secretary and treasurer of the Butler Drawbar Attachment Company, Cleveland, Ohio, died of pneumonia on February 12. Mr. Hayward had served as secretary and treasurer of the company since its organization. He has been succeeded by W. B. Waggoner.

The Chicago Pneumatic Tool Company, Chicago, has established a branch office at St. Louis, Mo., under the management of H. W. Buker, who succeeds J. D. Corby as district manager of sales. A stock room and service station will be maintained at St. Louis, as well as the district office.

C. C. Farmer, until recently assistant western manager and resident engineer for the Westinghouse Air Brake Company, has been advanced to the position of director of engineering of the same company with which he has been connected for many years. He was born in California, where he received his education. After a number of years as machinist on the Southern Pacific, he began, in 1891, a study of brake action and train control in the Westinghouse Air Brake Company instruction car, on various roads throughout the country. In the same year, the Missouri, Kansas & Texas offered him the position of supervisor of air brake repairs, from which he was advanced in a few months to air brake inspector of the entire road. In 1896 he became general air brake instructor of the Central of New Jersey and soon after became an inspector for the Westinghouse Air Brake Company. Not long after his second association with the Westinghouse Air Brake Company he was transferred to the Chicago district as mechanical expert. Then he was appointed resident engineer, and later, with the understanding that he would still retain the title of resident engineer, he was made assistant western manager, from which dual position he has now been advanced to that of director of engineering.

C. C. Farmer

A. W. Preikschat, formerly assistant to the engineer of tests of the Pullman Company, and later special representative in the purchasing department of the Steel Tube Company of America, has been appointed sales representative of the Liberty Steel Products Company, Inc., with offices in the McCormick building, Chicago.

W. Jerry Stanton has resigned as sales manager of the Railway Improvement Company to become special representative of the National Railway Appliance Company, New York. Mr. Stanton was employed by the General Electric Company for a period covering 18 years in the testing, engineering and sales departments.

At the organization meeting of directors of the Air Reduction Company, Inc., New York, held on February 19, the following officers were elected: President, A. S. Blagden; vice-president, A. R. Ludlow; treasurer, C. E. Adams; secretary, M. W. Randall; assistant treasurer, C. L. Snow, and assistant secretary, C. C. Emerson.

The Rich Tool Company, Chicago, announces the appointment of J. L. Crowley as special railroad representative, with headquarters at the company's main offices, Railway Exchange building, Chicago. H. W. Ullman has been appointed sales representative in the St. Louis territory, with offices at 203 Security building, St. Louis, Mo.

Fred Mathews, sales representative of the Union Metal Products Company at Chicago, has been appointed southern manager of the Standard Railway Equipment Company, the Pressed Steel Manufacturing Company, the Imperial Appliance Company and the Union Metal Products Company, with headquarters in the Candler building, Atlanta, Ga.

The Quigley Furnace Specialties Company, New York, has opened a branch office in the Turks Head building, Providence, R. I., in charge of F. W. Reisman, who has been the company's eastern New England representative for Hytempite, a high-temperature, firebrick cement, and insulating brick, as well as the Quigley air transport system for distributing and burning powdered coal and other fuels.

Huntly H. Gilbert, who left the service of the Pressed Steel Car Company and Western Steel Car & Foundry Company at the start of the war to enter the army as captain in the Ordnance Department at Washington, and later was commissioned major and transferred to the Rock Island Arsenal, has re-entered the service of the above named companies, as assistant manager of sales for the western district, located at 425 Peoples Gas building, Chicago.

W. B. Gibson, manager of the mining machinery department of the Allis-Chalmers Company, of Milwaukee, Wis., has been appointed manager of the small tank department of the William Graver Tank Works, Chicago, and R. C. Huntington, manager of sales promotion of the Fuller Rubber Company, Hampton, Ohio, has been placed in charge of department of sales, promotion and advertising of the William Graver Tank Works at Chicago.

George Sherwood Hodgins, of the editorial staff of Railway and Locomotive Engineering, died at his home in New York on January 18, at the age of 59 years. A graduate of the Upper Canada College and the School of Applied Science, affiliated with the University of Toronto, he afterward served an apprenticeship in the Kingston Locomotive Works. After some experience in a division master mechanic's office on the Canadian Pacific, he was advanced to various positions on the road, and latterly was locomotive inspector on the entire system. He was recalled to the Kingston Locomotive Works as mechanical engineer. Later he entered the service of the Pressed Steel Car Company as general inspector of the output of that plant, and was also for some years inspector for the Richmond Locomotive Works. During these earlier years he had contributed to a number of railroad publications. In 1900 he entered the field of practical journalism as editor of the Railway Digest. In 1902 he joined the staff of Railway and Locomotive Engineering, as associate editor, and in 1908 became managing editor, which position he held till 1911, when he was called by the Canadian government to make a comprehensive report on the shops, appliances, tools and equipment necessary for the Trans-Continental Railway. On the completion of that work in 1915, Mr. Hodgins joined

G. S. Hodgins

the staff of the Railway Periodicals Company as managing editor of the Railway Master Mechanic and Railway Engineering and Maintenance of Way. In 1916 he returned to Railway and Locomotive Engineering and remained on the staff as editor until his death, besides contributing to popular science magazines.

P. C. Cady, office manager of the mechanical department of the New York Central at New York, has been appointed assistant secretary of the International Railway Supply Company, New York, which is the purchasing agent for the American Railroad Company of Porto Rico and the Trinidad Government Railways, and also the export department of the Pyle-National Company. Mr. Cady was in railroad service since 1893, when he entered the mechanical department of the Lake Shore & Michigan Southern at Cleveland, Ohio.

John S. Y. Fralich has been appointed resident engineer of the western district for the Westinghouse Air Brake Company, succeeding C. C. Farmer. Mr. Fralich has been with the Westinghouse Air Brake Company since 1904. He was born at Harrisburg, Pa., September 19, 1880, was educated in the grade and high schools of Philadelphia, and received his engineering training at Williamson School. He then served a regular three years' apprenticeship as a machinist and was employed for two years as a machinist in the Altoona shops of the Pennsylvania Railroad. He became connected with the Westinghouse Air Brake Company in June, 1904, having been hired as a machinist, and shortly thereafter assigned to the inspection force. He was then respectively shop inspector, special inspector with the experimental test department, supervisor of shop tests and acting assistant to the mechanical engineer. He did special engineering work in the Chicago office from March to December, 1913, was appointed assistant resident engineer in December, 1913, and resident engineer of the western district February 1, 1919, as above noted.

J. S. Y. Fralich

Randolph S. Reynolds, secretary of the Curtain Supply Company, Chicago, died of pneumonia on January 20. Mr. Reynolds was with the Curtain Supply Company since 1912. Prior to that time he was with the Western Steel Car & Foundry Company, at Anniston, Ala., and the Pressed Steel Car Company, at Pittsburgh, Pa., having been connected with their purchasing departments from 1905 to 1912. He left the Pressed Steel Car Company in 1912 to accept a position with the Curtain Supply Company, and later was made assistant to general manager, and on April 30, 1918, was elected secretary to succeed Holmes Forsyth, who on that date became president.

The American Arch Company, New York and Chicago, announces the appointment of the following as traveling engineers of the company: E. S. Nicholas, with headquarters at Detroit, Mich., formerly boilermaker foreman of the Missouri Pacific shop at Kansas City, Mo.; M. R. Smith, with headquarters at St. Louis, Mo., formerly master mechanic at Coxton, Pa., on the Lehigh Valley; H. Darby, with headquarters at St. Paul, Minn., formerly motive power inspector of the Grand Trunk Pacific at Transcona shop, Winnipeg, Man., and J. D. Brandon, with headquarters at Montreal, formerly general foreman at the Brightwood shops, Indianapolis, Ind., of the Big Four. E. T. Mulcahy has again assumed his duties as traveling engineer of the American Arch Company, having been honorably discharged from the United States Army. Mr. Mulcahy's headquarters will be at Denver, Colo. Before coming with the American Arch Company Mr. Mulcahy was connected with the Union Pacific at its Cheyenne, Wyo., shops.

Railroad Administration Takes Over Superheater Company

Director General Hines announced on February 18 that the United States Railroad Administration, at the instance of the alien property custodian, had purchased more than 51 per cent of the stock of the Locomotive Superheater Company. According to Mr. Hines' statement, this stock originally belonged to German interests. The alien property custodian suggested that the interests of this government could be best protected through some governmental agency acquiring the stock. The purchase by the Railroad Administration will prevent effectively the passing of the stock back to German control.

At the annual meeting of the Locomotive Superheater Company, held at the office of the company, 30 Church street, New York City, the following directors were elected: J. S. Coffin, chairman; S. G. Allen, George L. Bourne, H. B. Spencer, Sanford H. E. Freund, J. N. Wallace, F. W. Scott, T. C. Powell and Henry Morgenthau Five of these, Messrs. Spencer, Freund, Wallace, Scott and Powell, are representatives of the Railroad Administration.

It was announced that as the affairs of the company have been satisfactorily managed by its officers, no change was made in the management. George L. Bourne, R. M. Osterman, F. A. Schaff and S. G. Allen were re-elected, respectively, president, vice-presidents and secretary; Henry Morganthau was elected treasurer, and T. C. Powell, director of the Division of Capital Expenditures of the Railroad Administration, was elected an additional vice-president of the reorganized company.

The Pulverized Fuel Equipment Corporation

The Pulverized Fuel Equipment Corporation has recently been organized for the purpose of taking over the business of the Locomotive Pulverized Fuel Company, and to broaden the activities of the latter to cover the central power station, metallurgical and industrial fields. The head offices are at 30 Church street, New York, with Canadian office in the Transportation building, Montreal.

This corporation installs and delivers in operation complete plants of its "Lopulco" system for the preparation, distribution, storage, feeding and burning of pulverized fuel for any steam generating or heating purposes whatsoever. The development by the Locomotive Pulverized Fuel Company of its "Lopulco" system for the burning of anthracite and bituminous coals, lignite and peat in pulverized forms, has already commercially demonstrated its adaptability for not only steam locomotives and steamships, but for central power station and other direct and waste heat stationary boilers, and for metallurgical and chemical furnaces and cement and other kilns. Many such installations are now in use and in process of construction in connection with public utility properties and large industrial and manufacturing plants.

The officers of the Pulverized Fuel Equipment Corporation will be: J. S. Coffin, chairman; J. E. Muhlfeld, president; H. F. Ball, executive vice-president; H. D. Savage, vice-president in charge of sales; V. Z. Caracristi, vice-president in charge of engineering; Samuel G. Allen, secretary-treasurer.

Catalogues

Tanks.—Bulletin 259 of the Walter A. Zelnicker Supply Company, St. Louis, Mo., contains a revised list of new and used tanks of all kinds and sizes that are for sale by this company.

Threading Machines.—The complete line of threading machines for bolts, nuts and pipe, manufactured by the Greenfield Tap & Die Corporation, Greenfield, Mass., is described and illustrated in Catalogue 41, which also gives the specifications for the machines and detailed information regarding parts for threading machines.

Electric Drills.—A four-page folder descriptive of the Thor line of portable electric drills and grinders has been issued by the Independent Pneumatic Tool Company, Chicago. These drills can be operated on either direct or alternating current. The bulletin contains a table showing capacities, speeds, dimensions, etc., of the various sized tools.

Powdered Coal Transport System.—Bulletin 10, a four-page pamphlet issued by the Quigley Furnace Specialties Company, New York, describes the Quigley air transport system for transporting and burning powdered fuel and contains several illustrations showing the operation of the system and the difference in structural work between a screw conveyor installation and the air transport system.

Graphite Products.—A new pocket catalogue has been issued by the Joseph Dixon Crucible Company, Jersey City, N. J., entitled "Dixon's Graphite Products." While not a complete catalogue, it furnishes a good idea of the variety of products made by this company. Pages are devoted to lists of articles especially for mills, railroads, automobiles, etc., with brief descriptions. Pamphlets dealing in detail with any one product may be had upon request.

Wrenches.—The Coes Wrench Company, Worcester, Mass., has issued a 14-page catalogue dealing with the line of screw wrenches and accessories made by this company. These include steel, knife and hammer handle wrenches. Information is given regarding their construction, manufacture and strength compared with other wrenches, as shown by tests made at the Harvard University testing laboratory. The catalogue contains a number of illustrations.

Steam Engine.—A detailed description of a high speed, piston-valve steam engine manufactured by the Ingersoll-Rand Company, New York, is contained in Bulletin No 9026, issued by that company. This engine is of the horizontal center crank type and is known as class "F P." The details of the machine are fully described and are shown in a number of illustrations. Four sizes are specified, ranging from 6 in. by 6 in. cylinders to 14 in. by 12 in. cylinders, and brake horsepower from 12 to 81.

Oxy-Acetylene Welding.—The Air Reduction Sales Company, New York, has published an attractive booklet, containing an outline of a short course for colleges and technical schools in oxy-acetylene welding and cutting, prepared by Alfred S. Kinsey, professor of shop practice and head of the department of shop practice at Stevens Institute of Technology, Hoboken, N. J. This was prepared to meet requests from college instructors for suggestions as to the best course to follow in teaching this subject.

Flanging.—An attractive catalogue entitled, "A Solution of Your Flanging Problems," containing 30 pages, 9 in. by 12 in., has been issued by the McCabe Manufacturing Company, Lawrence, Mass., illustrating and describing the wide range of work that can be done on the McCabe flanging machine, and showing economies that may be effected by its use. The greater part of the book is given over to illustrations showing finished products, such as various kinds of tanks, locomotive firebox and boiler sheets, steel car parts, etc.

Boilers.—"Boiler Logic" is the title of an 86-page treatise on steam boilers prepared by the Heine Safety Boiler Company, St. Louis, Mo. Six topics are discussed as follows: Some fundamental considerations of boiler design; practical baffling of water tube boilers; Heine boilers for different fuels, firing and services; overloads; the boiler as a pressure vessel, and details of construction of Heine boilers. A number of illustrations accompany the text, including a supplement in color of a Heine boiler set over an underfeed stoker.

Belt Fasteners.—The Crescent Principle of Belt Joining is the title of a four-page bulletin issued by the Crescent Belt Fastener Company, New York, describing the fasteners made by this company for joining all kinds of belting. These are claimed to give a flush joint, allowing the belt to have continuous contact with the pulleys. Several illustrations show completed joints with the various kinds of fasteners. The method of making the joints is also explained and illustrated. A ready reference chart, by means of which a belt man or machinist can readily determine the correct type of belt fastener to use for any condition of service is included in the bulletin.

Railroad Water Softening.—The Wm. Graver Tank Works, Chicago, has issued a treatise on the subject of water softening which consists of a collection of 31 reprints of full-page advertisements which are unusual in that little or no reference is made to any particular make or type of water softener, the material being almost entirely in the nature of a comprehensive exposition of the entire subject. Of particular note are 12 sheets presented in the form of articles covering various phases of this subject, prepared by W. R. Toppan, manager of the railroad department of the Wm. Graver Tank Works. These appear with such titles as "Operating Efficiency Increased by Purifying Water," "Water Softening in Relation to Ton Mileage," "The Method of Water Treatment Determines the Uniformity of Results." In addition to these 31 pages there is an eight-page appendix on the chemistry and economics of water softening. This serves to combine in a very short space a large amount of information required by the water service engineer in solving the problems arising in his work.

Forge Shop Equipment.—The Erie Foundry Company, Erie, Pa., has issued Catalogue F, containing 43 pages 8½ in. by 11 in., describing the Erie steam forging hammers, steam drop hammers, trimming presses and sheet galvanizing and shearing machinery. This catalogue is attractively arranged and contains a large number of illustrations. Two pages are devoted to each machine, one containing a description of the construction and the other an illustration of the machine with a table of specifications. Other illustrations show forgings made under Erie steam drop hammers and installations of this equipment in industrial plants. Several special features of design are separately described and illustrated, including a safety device for the protection of the operator from injuries caused by the breakage of top cylinder heads, an improved construction of guides and guide bolts which makes it unnecessary to remove the guide from the frame, an improved sow block or anvil cap, which eliminates the possibility of its working loose, and a throttle control. There are also several pages of instructions for erecting, operating and adjusting the Erie hammers and sketches showing the proper construction of the foundations, as well as drawings of the machines with all the parts numbered and named.

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CONTENTS

Don't Neglect Grinding Stands and Wheels

Observation of the conditions in a considerable number of railroad shops indicates that the grinding wheels and stands installed for free hand tool grinding are subjected to a great deal of abuse. These machines, although simple, are important and should be carefully selected and properly maintained. If either the stand or the wheel is not in the best of condition it will result in the workmen wasting time and spoiling tools. Grinding wheels cannot operate well unless they are firmly supported, and for that reason the stand should be rigid and equipped with a heavy spindle. A concrete foundation will give added stability and increase the life of the grinding wheels. Granting that the machine has been properly selected and installed, the next care should be to maintain the bearings in alignment without either end or side play.

One of the common mistakes in the use of grinding wheels is the selection of too hard a grade. This is often due to inadequate support for the wheel. If a soft wheel is allowed to vibrate it will wear down very quickly, and for that reason a hard wheel is some times chosen in an attempt to counteract the effects of a poor stand or a good stand improperly installed. On the other hand, hard wheels are sometimes chosen when the only argument in their favor is the increased life secured by their use. Harder wheels require more power to do the same amount of work, cut more slowly than soft wheels and are more apt to burn the tools. The development of grinding processes has undoubtedly been hindered in many railroad shops by the lack of knowledge of the properties of grinding wheels and failure to appreciate the advantages of and the wide field of application for grinding. Some few roads have done notable work in this direction; others should make better use of grinding processes. There is no better way to start than by putting the grinding stands in condition to give efficient service.

Tendencies in Boiler Design

The scientific design of locomotive boilers has developed rapidly in recent years. The tests conducted at Coatesville in 1912 demonstrated the relatively high evaporative value of firebox heating surface and these together with tests made at Altoona provide data which furnish a satisfactory basis for the rational design of boilers of moderate size. Large locomotive boilers, however, require further investigation.

A ratio of length to diameter of approximately one hundred to one is generally recognized as being the most desirable proportion for boiler tubes. If the tubes are lengthened beyond this limit, the heat absorption is increased very little, while the rate of evaporation is decreased and the vacuum required to maintain a given rate of combustion (and consequently the back pressure) is increased. The tubes can, of course, be shortened by making the combustion chamber longer. This sacrifices heating surface and while there is little evidence on which to base an opinion, many locomotive designers feel that it is not advisable to make a combustion chamber more than five feet long. If the length of the combustion chamber is limited to five feet, the tubes in the average Santa Fe or Mountain type locomotive will be about 20 or 21 ft. long. Assuming that 2¼-in. tubes are used, the ratio of length to diameter will be about one hundred and ten to one. Some roads are now using 2½ in. tubes and even larger sizes may prove desirable. As the flame area through the tubes is increased by the larger diameter, it may be advisable to shorten the combustion chamber.

There seems to be no good reason for retaining tubes of 2¼ in. diameter in large modern locomotives; nevertheless the practice is almost universally followed. It is probable that a ratio of length to diameter of approximately one hundred to one would prove the most economical and while the larger tubes needed to maintain this ratio would decrease the heating surface somewhat, they would very likely increase the boiler capacity. The problem is of great importance and steps should be taken to determine the best proportions for large locomotive boilers.

Eliminate Brake Beam Safety Chains

In glancing through a recent issue of one of the railroad employees' magazines, we were struck by three items telling of station agents who had been commended for noticing dragging brake beams on passing freight trains. These notices are compliments to the alertness of the men in station service, but are also a reflection on the mechanical department. Brake beams are recognized as frequent causes of derailments and thorough terminal inspection cannot prevent occasional failures of the hangers, yet few roads have equipped their cars with adequate safeguards to prevent danger from falling beams. This criticism does not apply to cars built in recent years, as improved safety guards have been used extensively on new equipment since their introduction; but little has been done toward replacing the safety chains which until a few years ago were practically standard equipment. The brake beam safety chain has so many defects that it should be replaced as rapidly as possible, and some standard device for supporting beams in case the hanger fails should be adopted by the Mechanical Section of the American Railroad Association. Such a device should, if possible, be made of materials commonly carried in stock; it should be of substantial construction and not subject to wear by reason of vibration. It would be desirable also to incorporate in it some means for insuring even brake shoe wear and for preventing the bottom brake rod from falling to the track in case the pin by which it is joined to the brake lever should work out.

Why Car Repairs are Behind

In his paper before the Central Railway Club on March 14, J. J. Tatum, general supervisor of car repairs of the Railroad Administration, gave an excellent presentation of the conditions required to bring about a satisfactory car repair situation. As is usually the case, however, the difficulty lies in the practical application of the principles enunciated. It is doubtful if anyone, even though he may have resorted to the practice himself, will attempt to defend the practice of clearing repair tracks by removing bad order cards, but a strict adherence during the war to principles of car maintenance which are generally recognized as correct, would probably have resulted in a complete tie-up of the transportation system within a week. The real crux of the whole situation is a falling behind on the purchase of new cars for renewals and a general lack of sufficient car repair facilities throughout the country.

The business of the railroads is to move traffic, and nothing can be allowed seriously to interfere with this, even temporarily. If traffic is waiting to be moved, cars must be furnished so long as there are any in sufficiently good condition to turn a wheel. There is little hope, therefore, of bringing about an improvement in conditions during a period of unusually heavy traffic movement. The inexcusable feature of the whole situation is the failure to take full advantage of such facilities as are available when conditions permit the release of the cars for heavy repairs.

The lack of facilities was hinted at in Mr. Tatum's paper. While it may be impossible for the Railroad Administration to carry out any extensive plans for increasing facilities, it has already rendered a real service in its campaign for unification of car inspection and repairs by drawing general attention of operating and administrative officers to the needs of the situation. To what extent this will be followed by action, particularly to increase facilities, will depend largely upon the final settlement of the whole railroad problem.

Wheel Arrangement and Boiler Proportions

One of the outstanding features of the Philadelphia & Reading Consolidation type locomotive, a description of which appears elsewhere in this issue, is the tractive effort which has been obtained in relation to the proportions of the boiler which it is possible to place on the 2-8-0 wheel arrangement. The tractive effort of 61,260 lb. has probably been exceeded only by that of the Delaware & Hudson pulverized fuel burning Consolidation type locomotive built three years ago, which is 61,400 lb. For heavy drag service, which the engines are designed to handle, it is apparent that tractive effort at slow speeds is relatively of greater importance than high sustained horsepower capacity at the speeds coincident with the maximum horsepower rating of the locomotive, and under such conditions the reduced first cost and maintenance which may be expected from the absence of a trailer are worthy of consideration. It is only on this basis that the sacrifices in boiler capacity with this wheel arrangement can be justified.

But considering the boiler of this locomotive alone, entirely aside from its relation to the cylinder capacity, the use of tubes 13 ft. 6 in. long appears to be shorter than is demanded for the highest efficiency. The best ratio of length to diameter of tubes, considering both capacity per unit weight and efficiency, is 100. With 2-in. tubes, which are in use on the Philadelphia & Reading locomotive, the ratio of length to diameter is 81, a considerable reduction from the generally accepted ratio. The sacrifice in tube length is partially accounted for by the inclusion of a combustion chamber, which is desirable for the best results in getting the heat out of the fuel, but it is evident that with the short tubes this will be partially offset by a loss of efficiency due to the higher front end temperatures. It is doubtful whether the best results, from the standpoint of efficiency, any more than from the standpoint of capacity, can be obtained with the 2-8-0 type, with tubes of the usual diameters.

Keep up Standards on New Work

The failure of Congress to pass the bill authorizing the appropriation which the Railroad Administration requested makes it necessary to curtail expenses until another revolving fund is provided. This unfortunate financial condition is already affecting the expenditures for improvements and has brought work on many partially completed projects to a standstill. Under these circumstances there is a powerful temptation to complete unfinished installations with the least possible additional outlay and it may not be out of place to sound a warning against the purchase of cheap equipment in order to stretch the appropriations.

There is often a noticeable tendency on railroads to give more consideration to first cost than to the cost of operation, due probably to the fact that requisitions are handled by purchasing officers who are interested in securing low prices but have little conception of the suitability of the equipment they purchase, or the great differences in the cost of operation that may exist between apparently similar types. Under present conditions, when it is difficult to secure authority for expenditures, railroad men are apt to figure their minimum requirements and accept facilities which their judgment tells them will prove wasteful in the end. There is every reason to believe that the traffic on railroads in this country will increase as rapidly in the future as it has in the past and that the motive power and rolling stock will continue to grow larger. Facilities which meet present requirements with little excess capacity for future demands are almost sure to prove inadequate in a few years. In the end it is more important that whatever is done be done right, than that a greater number of things be done in a half-hearted way.

There seems to be no question that the railroads will soon be given sufficient revenues to enable them to make the needed extensions to their properties. For that reason, it is advisable to make the best of present facilities for the time being with a view to making all improvements adequate to take care of future requirements. Whether it is a matter of adding to shop facilities or improving locomotives or cars, the mechanical department officers must realize the importance of choosing the course that will in the end prove the most economical and of standing firmly by the decision in spite of the obstacles with which they are confronted at the present time.

The Mechanical Associations

The convention season is fast approaching and railway mechanical department officers and foremen are giving much thought to the problem of the future welfare and development of the various railway mechanical department associations. The two major organizations, the American Railway Master Mechanics' Association and the Master Car Builders' Association, under the new order of things will be combined into the Mechanical Section of the American Railroad Association. Except that the names of the two organizations will be discarded and their efforts will be combined, it would appear that there is no reason why the good work that they have done in the past should not go steadily forward but at a faster pace. While these two associations have made many recommendations in the past, it has been impossible to make them generally effective, except insofar as the various roads subscribed to the Master Car Builders' rules of interchange. It has been suggested many times that the recommendations of the two associations should be passed on and approved by the American Railway Association but even that organization has had no way of generally enforcing its recommendations. The new organization provides that the various sections should report direct to the American Railroad Association and that its recommendations in turn should go to the Railroad Administration which has the power to make them effective throughout the roads under its control.

It is, of course, somewhat of a question as to just what will happen when the railroad properties are returned to the private managements, but it would seem that some steps should be taken to the end that the American Railroad Association should have authority to put into effect such recommendations as may be made to it by its various sections after full investigation, study and discussion, and which in turn receive the approval of the higher organization. If this can be done, then the amalgamation of the two major mechanical associations as a section of the American Railroad Association promises to add very greatly to the importance of such work as may be done by the Mechanical Section.

A careful study of the constitution and by-laws indicates that the different sections of the American Railroad Association will be left to work out their problems largely in their own way and there appears to be no good reason why any of their past methods or practices should be upset, provided they have been found effective. Regardless of what the future may hold, however, the mechanical department officers and foremen should make every possible use of the opportunity that lies before them in demonstrating their ability to meet the larger problems that now confront them. The past three years have brought vividly before the higher executive officers the importance of the equipment and maintenance situation. If a mechanical man proves that he is a master of those things which come within his province, he is bound to be listened to with attention. The great difficulty is that many of the mechanical department officers have allowed their lights to be hidden under a bushel and it is not strange that in some cases they have not inspired confidence on the part of their superiors. They have a great opportunity to overcome this deficiency at the present time.

Just what disposition is to be made of the minor mechanical department associations does not as yet appear. It would seem wise, however, that they should be allowed to preserve their individuality but that some channel be provided so that their findings will automatically go to the Mechanical Section of the American Railroad Association and either be approved and made standard or recommended practice, or be referred back to the minor organizations for further consideration. One great handicap to the minor mechanical organizations has been that they have lacked in official recognition and although their work has been a great help and inspiration to the members and to those who have followed their proceedings closely, their recommendations and findings have not had the force that they should have had. It may be well to more clearly define the exact field and limitations of each of the associations in order that the entire mechanical department be covered by these minor organizations and that there be no overlapping.

Thus far the Railroad Administration has asked the managements of the different roads to see that as many of the members of the various organizations as possible be sent to the conventions. Apparently, this practice is to be continued, at least in the case of all of the associations that receive the approval of the Administration. The result will be that the attendance in all cases will be larger and more representative than it has been in the past and this should do much to encourage the officers and committee chairmen in putting forth extra efforts to make the meetings of the very greatest possible value.

The reports and papers for the June mechanical conventions are being rapidly turned in to Secretary Hawthorne, and it is expected that all of them will be in the hands of the members at a much earlier date than usual. The conventions will be watched more closely and critically than ever before and every member should take a pride in going to Atlantic City prepared to discuss the reports intelligently and with the idea of going back to his home road prepared to advocate and make effective those things that are developed at the convention that seem to him to be of the greatest practical value. Officers at the head of the mechanical departments should encourage their subordinates in this respect and will do well to ask for a written report of recommendations from each one who attends the meetings. This will tend to encourage the men to crystallize their thoughts and findings and will add much to the returns that may be expected from the conventions.

NEW BOOKS

Mechanism of Combustion. By J. T. Anthony, vice-president, American Arch Company, New York. 24 pages, 8 in. by 10½ in., illustrated, bound in paper. Distributed by American Arch Company, 30 Church street, New York.

The American Arch Company is issuing a series of bulletins dealing with the subject of combustion and the transfer of heat, of which the bulletin on The Mechanism of Combustion is the second. This bulletin presents in a very clear manner the various processes that take place in the combustion of coal. It explains the molecular construction of fuel and shows just what transformations occur in its combustion and why they occur. In other words, a very well merited attempt is made to explain the "mechanism" of combustion. The illustrations included in the pamphlet serve as a tremendous aid to the reader in visualizing the chemical processes of combustion. The pamphlet also shows where and how the heat is generated from fuel by the process of combustion. It discusses first the structure of atoms and molecules and explains the hydrocarbon molecules which are found in fuel. It explains the action of these atoms and molecules in the coal in both the quiescent and active (when the coal is burning) state. It fully explains why and how the heat is obtained. The pamphlet is strongly recommended to those desiring to learn more of the secrets of the combustion of coal.

COMMUNICATIONS

INADEQUATE MAIN BOXES

Brooklyn, N. Y.

To the Editor:

The communication from J. H. Buck on the subject of "Inadequate Main Boxes," published in your issue of March, 1919, calls attention to a defect which has developed very rapidly in large modern locomotives. The writer does not agree with Mr. Buck that larger boxes and bearings would remedy the evil. An extension of bearing surface toward the neutral axis of the locomotive has not even proved palliative and an enlargement of journal diameter is open to the objection that the increased surface velocity of the journal might cause heating.

In order to call attention to some ratios which seem to have been neglected in modern locomotive design, the writer has prepared the table, embracing characteristics of four types of locomotives, namely, four-coupled, six-coupled, eight-coupled and ten-coupled. The writer has chosen a maximum static rail load of 30,000 lb. per wheel, and in order to make driving box conditions as nearly comparative as possible this load, the boiler pressure, the piston stroke and driving wheel diameter have been assumed as alike in each instance. The tractive effort is based on a factor of adhesion of four and appropriate cylinder diameters have been derived from the data.

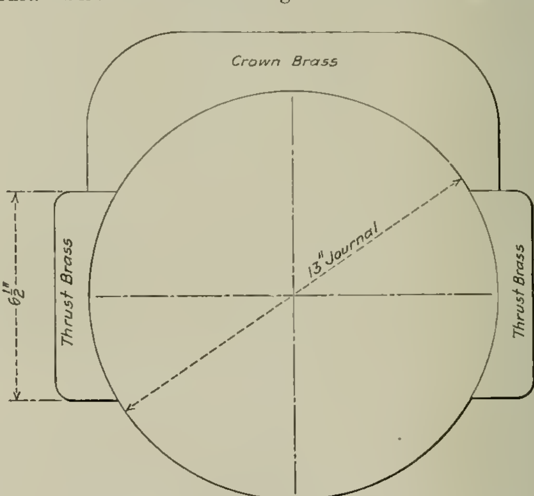
From the cylinder areas and boiler pressure, piston thrusts are derived. Journal sizes corresponding to current practice are given. In the table, line 4 has been derived from line 3 by subtracting the dead weight of one-half the axle, the wheel, the crank-pin and the attached rods. By reason oi the fact that these weights are somewhat greater in the ten-coupled than in the four-coupled engines the live loads carried by the journals are less in the ten-coupled engine than in the four-coupled. The vertical bearing pressures

1—Number of driving wheels	4	6	8	10
2—Total weight on driving wheels, lb.	120,000	180,000	240,000	300,000
3—Weight on each driving wheel, lb.	30,000	30,000	30,000	30,000
4—Live load on each main journal, lb.	27,500	27,235	26,950	26,650
5—Tractive effort (ratio of adhesion = 4), lb.	30,000	45,000	60,000	75,000
6—Boiler pressure, lb. per sq. in.	200	200	200	200
7—Piston stroke, in.	30	30	30	30
8—Diameter of driving wheels, in.	63	63	63	63
9—Cylinder diameter (derived), in.	19¼	23⅝	27⅛	30½
10—Piston thrust, lb.	57,454	87,672	115,574	146,124
11—Size of journals, dia. and length, in.	10x15	11x15	12x15	13x15
12—Vertically projected area of bearings, sq. in.	150	165	180	195
13—Horizontally projected area of bearings, sq. in.	75	82½	90	97½
14—Vertical bearing pressure, lb. per sq. in.	183	165	149	136
15—Horizontal bearing pressure, lb. per sq. in.	766	1,062	1,284	1,498
16—Line 10 divided by line 4	2.08	3.22	4.29	5.48

per square inch are obtained by dividing the figures in line 4 by those in line 12. Line 13 is based on the assumption that the bearing embraces only the upper half of the journal. The horizontal bearing pressures are obtained by dividing the figures in line 10 by those in line 13.

A perusal of the figures in line 14 (vertical bearing pressures) and line 15 (horizontal bearing pressures) reveals some interesting information. The vertical bearing pressures per square inch have decreased progressively as the size of the locomotive has increased, owing to the fact that the journal dimensions have increased, while the live load carried has slightly decreased. The horizontal bearing pressures due to piston thrusts have increased progressively with the increase of locomotive capacity. In other words, the bearings of the ten-coupled engine will wear in the vertical direction only 75 per cent as fast as will those of the four-coupled engine, while in the horizontal direction the bearings of the ten-coupled engine will wear 194 per cent as fast as those of the four-coupled engine. Thus, it will be seen that the tendency of the bearings to wear open at the points will be greater in the ten-coupled engine. That these are facts and that the effect is as described, no one can deny. The foregoing relates entirely to friction and wear.

In line 16 we find a ratio which, to the writer's knowledge, has never been used. This is the ratio between the piston thrust and the pressure downward which holds the bearing on the journal. During the writer's experience as a locomotive engineer he handled a class of heavy tandem compound ten-coupled engines. When working at full capacity these engines raised the main boxes from their journals. So pronounced was this tendency to rise that it caused an epidemic of broken oil cellars, which was cured only by increasing the clearance between the journal and the cellar. This would make it appear that the half-shell brass is, in effect, an inclined plane the angle of which depends upon and varies with the weight on the journal and the piston thrust. Somewhere in the range of the writer's table the



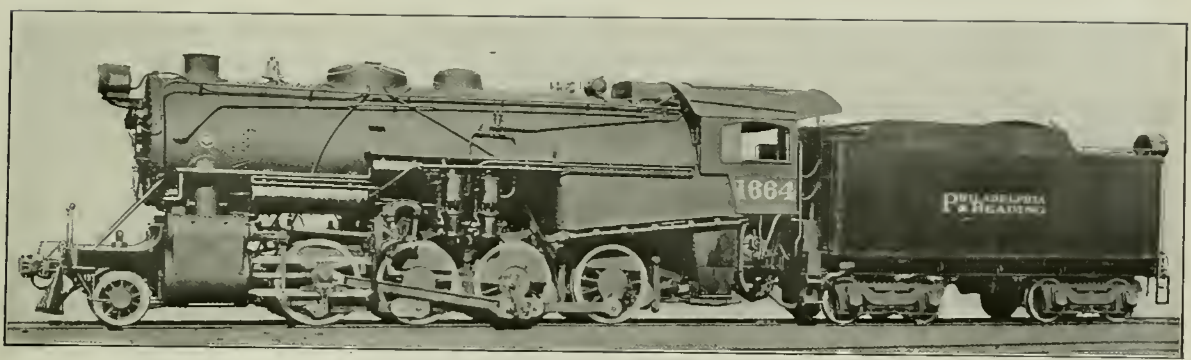
Proposed Arrangement of Driving Box Bearings

critical angle at which the box tends to rise from the journal could, no doubt, be found by experiment. It would probably be quite difficult to determine this angle mathematically, but the remedy is easily determined.

It is the writer's opinion that this tendency to rise is the principal reason for the rapid deterioration of main boxes in heavy power and that the only real remedy lies in providing bearing surface below the center line of the journal, as shown by the sketch submitted. By this means a horizontally projected bearing area 50 per cent greater than that ordinarily provided may be obtained. Such an increase would reduce the horizontal bearing pressure from piston thrust in the ten-coupled engine to 999 lb. per sq. in., which would probably vastly improve the wearing qualities. The tendency to rise from the journal would also be overcome.

Such a re-arrangement of the bearing surfaces would involve a radical departure from present practice, but it can be done, and there is no good reason for adherence to the antiquated half-shell bearing which has been long since outgrown. The heavy stationary engine has quarter boxes in which the bearing entirely encircles the journal and the brasses are adjustable in all directions for wear, while modern locomotives must get along with the half-shell non-adjustable boxes of seventy-five years ago. It would seem that a discussion of the points referred to in this letter might develop something of interest.

Charles F. Prescott.



Heavy Consolidation Type Locomotive Built for the Philadelphia & Reading

P. & R. LARGE 2-8-2 TYPE LOCOMOTIVE

Tractive Effort is 61,260 lb.; Boiler has a Combustion Chamber and 2-in. Tubes 13 ft. 6 in. Long

THE Philadelphia & Reading has recently received from The Baldwin Locomotive Works a number of Consolidation type locomotives which are notable for their weight and hauling capacity, and also because they are the only engines built to a railroad company's design to be included in the Railroad Administration orders last year.

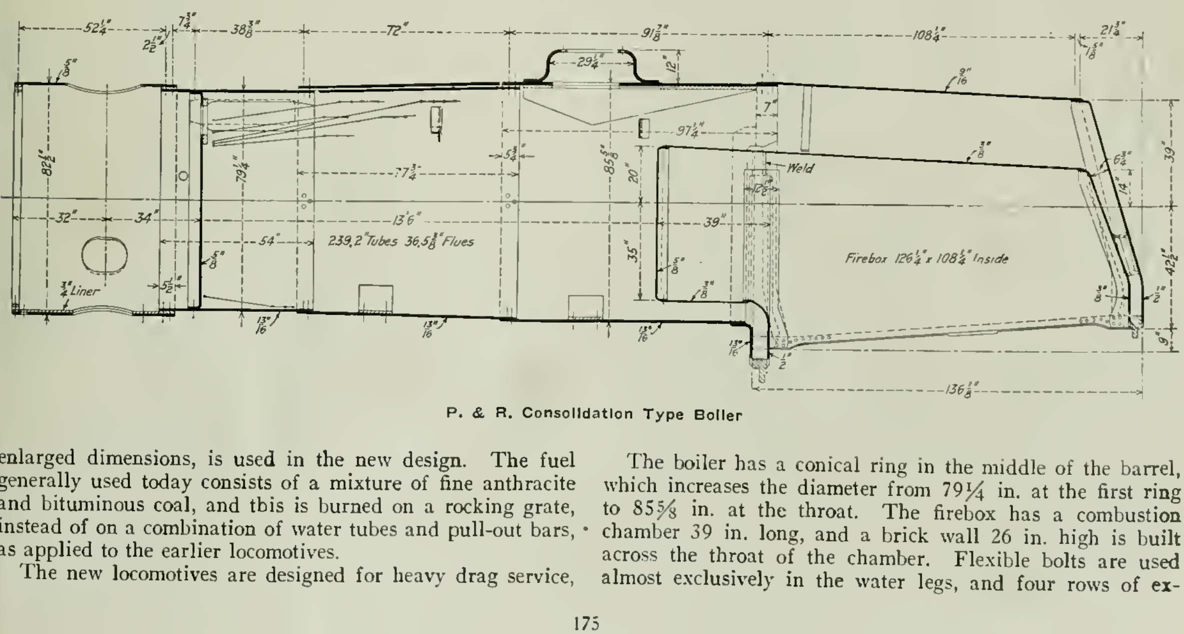
In the table will be found a comparison of the leading dimensions of these locomotives with the first Baldwin Consolidation type built for the Philadelphia & Reading:

Date built	Cylinders, in.	Drivers, diam., in.	Steam pressure lb. per sq. in.	Grate area, sq. ft.	Water heating surface, sq. ft.	Superheating surface, sq. ft.	Weight on drivers, lb.	Total weight, lb.	Tractive effort, lb.
1880.....	20 x 24	50	120	76	1,357	...	90,000	104,000	19,600
1918.....	25 x 32	55½	200	94.9	2,655	575	250,800	281,100	61,200

The locomotives built in 1880 had boilers of the Wootten type, equipped for burning fine anthracite, and this same type of boiler in a somewhat modified form and of greatly enlarged dimensions, is used in the new design. The fuel generally used today consists of a mixture of fine anthracite and bituminous coal, and tbis is burned on a rocking grate, instead of on a combination of water tubes and pull-out bars, as applied to the earlier locomotives.

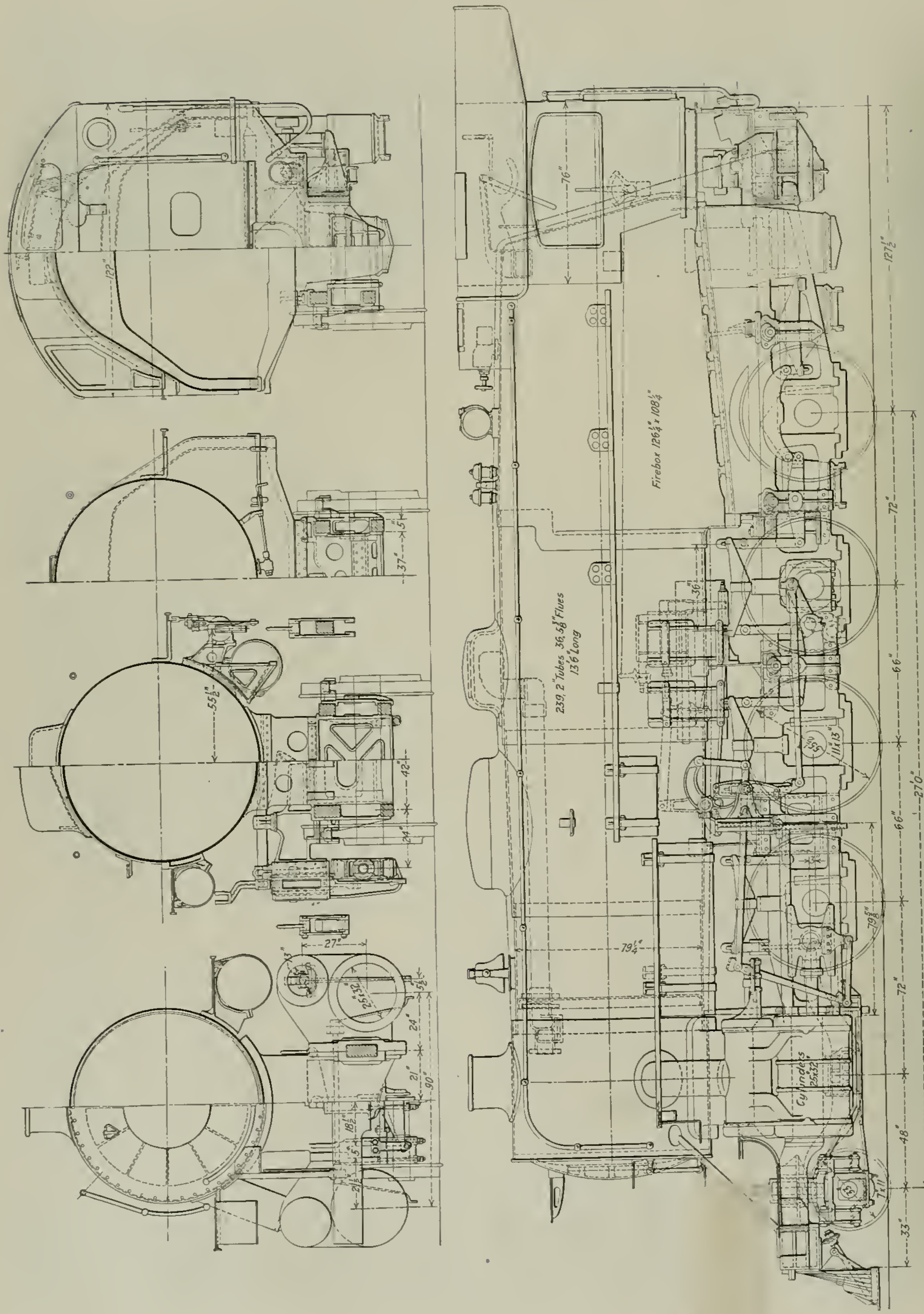
The new locomotives are designed for heavy drag service, and are in many respects similar to a group of Mikado type locomotives which preceded them. In consideration of the kind of fuel used, however, and the relatively small diameter of the wheels, a firebox of sufficient depth can be placed above the rear drivers without raising the boiler center to an excessive height. In the new Consolidations, the boiler center is placed 9 ft. 7½ in. above the rail.

In the following table will be found a comparison of the principal dimensions and ratios of the Consolidation and Mikado types. It will be seen that the new locomotives have smaller driving wheels and lower boiler pressure than the Mikados, but the cylinders are one inch larger in diameter and they have a starting tractive effort almost 4,000 lb. greater than the Mikados. It is evident that there is a considerable sacrifice in heating surface; there are eight less superheater units and 20 less tubes, and they are 4 ft. 2 in. shorter than those in the Mikado type boiler. The difference in grate area is less marked. For heavy drag service, however, high tractive effort at slow speeds is the controlling factor rather than a high sustained horsepower capacity.



P. & R. Consolidation Type Boiler

The boiler has a conical ring in the middle of the barrel, which increases the diameter from 79¼ in. at the first ring to 85⅝ in. at the throat. The firebox has a combustion chamber 39 in. long, and a brick wall 26 in. high is built across the throat of the chamber. Flexible bolts are used almost exclusively in the water legs, and four rows of ex-

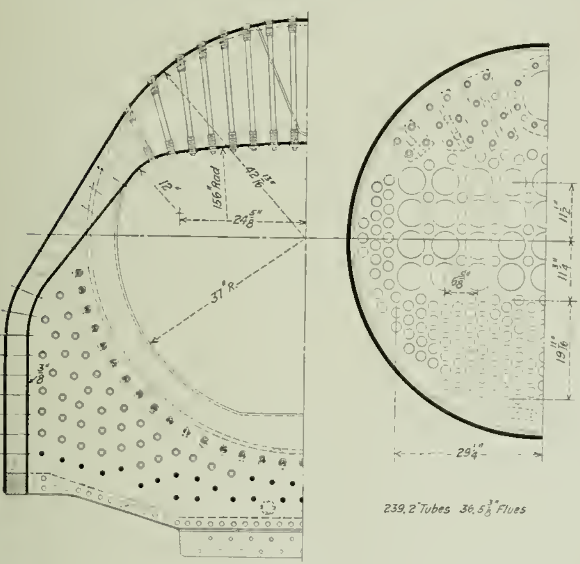


Elevation and Sections of the P. & R. Consolidation Type Freight Locomotive pansion stays support the front of the crown. The firebox has two oval fire-door openings, and the doors are power operated. A Standard stoker is applied. The mud ring is single riveted, except at the corners, where it is increased in depth to take two rows of rivets. A four-hopper ash-pan is applied with the two rear hoppers back of the wheels outside the frames. The equipment includes a power grate shaker.

The smokebox is comparatively short, and is equipped with the Economy front end arrangement,* and patented I. A. Seiders, superintendent of motive power and rolling equipment of the railroad. A special feature of this arrangement is a breaker plate, which consists of a slotted plate fitted with deflecting vanes. This plate is placed under the superheater damper and in front of the tubes, and is very effective in breaking up the large sparks before they strike the netting. The netting frames are most substantial in construction, and the device has proved effective in preventing the setting of fires due to escaping sparks.

Comparison of P. & R. Consolidation and Mikado Type Locomotives

Type	2-8-0	2-8-2
Tractive effort, lb.	61,260	57,320
Total weight, lb.	281,100	329,300
Weight on drivers, lb.	250,800	246,600
Diameter of drivers, in.	55½	61½
Cylinders, diameter and stroke, in.	25 by 32	24 by 32
Steam pressure, lb. per sq. in.	200	225
Heating surface, total evap., sq. ft.	2,655	4,224
Heating surface, equivalent, sq. ft.	3,518	5,264
Grate area, sq. ft.	94.9	108
Tractive effort x dia. drivers ÷ equiv. heating surface	966.5	669.7
Firebox heating surface ÷ equiv. heating surface, per cent	8.4	6.2
Grate area ÷ vol. cylinders	5.2	6.4



Half Section Through the Wootten Firebox and Half Tube Sheet Layout

The cylinders are cast separate from the saddle, the right and left hand cylinders being interchangeable. They are made without bushings, and have barrel walls 2¼ in. thick. The cylinder castings and central saddle are made with suitable recesses through which the frames pass. The frame at this point has a single section, 5 in. wide by 13 in. deep—and the cylinder, frame and saddle are held together on each side by a total of 59 horizontal bolts, 1⅛ in. in diameter. The saddle and cylinders are keyed to the frames at the front by vertical keys. The valve motions are of the Walschaert type, and are controlled by the Ragonnet power reverse gear.

The frames are of most substantial construction. They have a depth of 7½ in. above the pedestals, and the pedestal binders are held in place by three bolts in each end. The main pedestal wedges are self-adjusting. Strong transverse braces of cast steel are applied to the frames between adjacent pairs of driving-wheels. The brace back of the main drivers supports sliding bearings, which carry the front end of the mud ring. The rear end is supported by an expansion plate.

The cab, in accordance with the most recent practice for Wootten boiler locomotives on this road, is placed at the rear end instead of over the middle of the barrel. The sides of the cab are cut away in front in order to permit easy access to the stay-bolts.

Further particulars are presented in the following table of dimensions and data:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Hard and soft coal, mixed
Tractive effort	61,260 lb.
Weight in working order	281,100 lb.
Weight on drivers	250,800 lb.
Weight on leading truck	30,300 lb.
Weight of engine and tender in working order	462,000 lb.
Wheel base, driving	17 ft.
Wheel base, total	27 ft.
Wheel base, engine and tender	63 ft. 11 in.

Ratios.

Weight on drivers ÷ tractive effort	4.1
Total weight ÷ tractive effort	4.6
Tractive effort × diam. drivers ÷ equivalent heating surface*	966.5
Equivalent heating surface* ÷ grate area	37.1
Firebox heating surface ÷ equivalent heating surface,* per cent	8.4
Weight on drivers ÷ equivalent heating surface*	71.3
Total weight ÷ equivalent heating surface*	79.9
Volume both cylinders	18.2 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	193.5
Grate area ÷ vol. cylinders	5.2

Cylinders.

Kind	Simple
Diameter and stroke	25 in. by 32 in.

Valves

Kind	Piston
Diameter	13 in.

Wheels

Driving, diameter over tires	55½ in.
Driving, thickness of tires	6½ in.
Driving journals, diameter and length	11 in. by 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	7 in. by 11 in.

Boiler

Style	Wootten conical
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	79¼ in.
Firebox, length and width	126¼ in. by 108¼ in.
Firebox plates, thickness	Sides, back and crown, ⅜ in.; tube, ⅝ in.
Firebox, water space	Front, 5 in.; sides and back, 4 in.
Tubes, number and outside diameter	239—2 in.
Flues, number and outside diameter	36—5⅜ in.
Tubes and flues, length	13 ft. 6 in.
Heating surface, tubes and flues	2,359 sq. ft.
Heating surface, firebox†	296 sq. ft.
Heating surface, total	2,655 sq. ft.
Superheater heating surface	575 sq. ft.
Equivalent heating surface*	3,518 sq. ft.
Grate area	94.9 sq. ft.

Tender

Tank	Water bottom
Wheels, diameter	36 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	9,500 gal.
Coal capacity	15 tons

*For description and illustrations of this device see the *Railway Mechanical Engineer* for February, 1918, page 118.

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.
†Includes combustion chamber.

Railroad Administration News

Shop Crafts Present Demands for Further Wage Increases; Orders of the Regional Directors

Two representatives of each regional director and an equal number of representatives of the Brotherhood of Maintenance of Way Employees and Shop Men began a meeting at Washington on March 10 for the purpose of recommending to the Board of Wages and Working Conditions a set of uniform rules governing working conditions. A tentative draft was submitted to the board by the brotherhood some time ago.

DIVISION OF FINANCE AND PURCHASES REORGANIZED

John Skelton Williams has resigned as director of the Division of Finances and Purchases of the Railroad Administration, effective March 15, and the division has been divided into two new ones, the Division of Finance and the Divison of Purchases. Swagar Sherley, chairman of the House Committee on Appropriations in the Sixty-fifth Congress, who had charge of the railroad appropriation bill which passed the House, has been appointed director of the Division of Finance, effective about April 15, and Henry B. Spencer, formerly chairman of the Central Advisory Purchasing Committee, has been appointed director of the Division of Purchases. For the time being, Director General Hines will himself direct the work of the Division of Finance with the assistance of the associate director of the Division, Charles B. Eddy.

Mr. Williams is now chairman of an advisory finance committee, which will be expected to submit to the director general from time to time its advice on matters of financial policy and also to make to the director general preliminary reports on any proposed reorganizations which may require his approval. He is also chairman of an advisory committee on purchases, the other members of which are Robert S. Lovett, president of the Union Pacific, and Henry Walters, chairman of the Atlantic Coast Line. This committee will submit to the director general from time to time its advice regarding matters of policy with respect to purchases and for that purpose is authorized to make the necessary investigations.

Circular No. 1 of the Division of Purchases announces that Samuel Porcher and George G. Yeomans, heretofore members of the Central Advisory Purchasing Committee, are appointed assistant directors of the Division of Purchases, and William W. Morris, heretofore secretary of the Central Advisory Purchasing Committee, is appointed assistant to the director, Division of Purchases.

H. C. Pearce, manager, Procurement Section; M. E. Towner, manager, Forest Products Section; E. J. Roth, manager, Stores Section; and B. P. Phillippe, fuel distributor heretofore reporting to the chairman of the Central Advisory Purchasing Committee, will report to the director of the Division of Purchases.

WAGE DEMANDS FOR 1919

Now that most of the back pay for 1918 has been taken into the accounts, the processes which are expected to result in a new series of retroactive payments for 1919 are still being continued. The request of the train service brotherhoods for an upward revision of their wage scales and time and one-half for overtime is still pending, on a recommendation of the Board of Wages and Working Conditions which is before the director general for a decision. The award when issued is expected to be retroactive to January 1, and the shop employees have asked for a new increase to become effective as of the same date.

A letter addressed to the director general by B. M. Jewell, acting president of the railway employees' department of the American Federation of Labor, and the executives of the individual organizations, says that great dissatisfaction has been manifested by the machinists, blacksmiths, boilermakers, sheet metal workers, electricians and car men, regular and helper apprentices and helpers, "due to the present inadequate wage rates," as contained in the awards made in 1918, and they desire to present a request for further increase "to place them in a position to meet the ever-rising cost of living and maintain a more equal differential between classes of railroad employees and those engaged in a similar capacity in other industries." The letter states that these employees have been very insistent in their demands for some time, but the request has been withheld until they have become so persistent that it has been deemed advisable to comply with their wishes. The letter also urges upon the director general the necessity of arranging a conference with the representatives of the shop crafts for the purpose of arriving at a thorough understanding of the award to be issued covering this request, prior to the issuance of the general order.

The new scale of rates requested provides for a minimum hourly rate of 85 cents an hour, as compared with the present minimum of 68 cents, for machinists, blacksmiths, sheet metal workers, electrical workers, car men and boilermakers, a minimum hourly rate of 60 cents an hour for helpers, and differentials above the minimum hourly rate for certain classes of employees. Machinists working on valve motion work, tool room work, rod work, heavy machine operators, layers out, air men and federal inspection men ask an excess of 6 cents an hour above the machinists' rate. Certain classes of boilermakers ask an excess of 6 cents above the boilermakers' rate. Blacksmiths employed as hammersmiths and electricians employed as armature winders ask an excess of 25 cents above the rate for the respective crafts, making their rates $1.10 an hour.

The request provides that general foremen, foremen, assistant foremen, and leaders shall be paid on an hourly basis and receive overtime compensation for all services rendered in excess of eight hours per day, with a minimum hourly rate of $1 for general foremen, 95 cents for foremen, and 90 cents for assistant foremen, gang foremen and leaders; provided that all rates in excess of these shall be continued and monthly rates now in effect shall be the basis for establishing the hourly rates, the monthly rates to be divided by 200 to obtain the hourly rate.

The request also provides that operators of electric, acetylene thermit or other improved welding processes or machines shall receive an hourly rate of 91 cents, that all employees performing the recognized work of any craft who have had one year's experience or less shall receive 67 cents an hour, who have had one year or less than two years' experience shall receive 70 cents an hour, two years' and less than three years', 74 cents an hour, over three years' and less than four years', 79 cents an hour. This does not include regular and helper apprentices. It is provided that should any of the above leave the service, employees with not less than four years' experience shall be assigned to their positions and paid the minimum rate. Regular and helper apprentices assigned in connection with the work of their respective crafts are to receive as a starting rate 35 cents an hour, with an increase of 2½ cents an hour for each six months up to and including the first three years, and an increase of 5 cents an hour for the first six months of the fourth year and 7½ cents an hour for the last six months of the fourth year.

INVESTIGATION OF THE WILLIAM H. WOOD FIREBOX

The William H. Wood corrugated locomotive firebox is the subject of a report recently made by Frank McManamy, assistant director, Division of Operation, United States Railroad Administration, by a sub-committee of the Committee on Standards and published by the Railroad Administration. The committee made a thorough investigation of the service records of the five fireboxes of this construction actually applied to locomotives and examined the fireboxes, now all replaced by others of standard design. Its conclusions are "that the Railroad Administration should not apply any of these fireboxes for the following reasons:

"That the economy claims have not been proven.

"That the life to be expected, based on the best performances is very much less than that of the ordinary form of box.

"That the time out of service will be very much greater than with the ordinary box."

The committee does not believe that there is sufficient advantage in this form of construction to compensate for the added difficulty and expense involved in its repair and renewal.

Obligations of the Railroad Administration for Equipment Ordered in 1918* with Unit Prices of Cars and Locomotives

The Standard Locomotive Orders
Recapitulation

Number	Type	Price	Amount
150	Light switchers	$36,029.00	$5,404,350.00
50	Light switchers	38,416.33	1,920,816.50
150	Heavy switchers	43,966.00	6,594,900.00
150	Heavy switchers	46,199.03	6,929,854.50
43	Light Pacific	50,867.00	2,187,281.00
25	Light Mikado	57,178.25	1,429,456.25
530	Light Mikado	53,619.00	28,418,070.00
150	Light Mikado	60,613.27	9,091,990.50
20	Heavy Pacific	53,924.00	1,078,480.00
35	Light mountain	56,995.00	1,994,825.00
217	Heavy Mikado	56,761.00	12,751,137.00
50	Heavy Mikado	63,686.90	3,184,345.00
5	Heavy mountain	61,929.00	309,645.00
150	Light Santa Fe	62,277.00	9,341,550.00
20	Light Santa Fe	68,918.16	1,378,363.20
50	Heavy Santa Fe	67,543.00	3,377,150.00
5	Heavy Santa Fe	73,395.81	366,979.05
100	Light Mikado	60,486.00	6,048,600.00
30	Light mallet	78,339.00	2,350,170.00
20	Heavy mallet	92,195.00	1,843,900.00
75	Heavy mallet	98,155.60	7,361,670.00
30	Consolidation	53,619.00	1,608,570.00
2,055	....	....	$114,972,103.00

Contracts for 100,000 Standard Cars
Recapitulation

Number	Type	Price	Amount
20,000	C. G.	$2,697.20	$53,944,000.00
25,000	Hopper	2,916.67	70,416,750.00
25,000	D. S box	2,918.88	72,972,000.00
25,000	S. S. box	3,050.05	76,251,250.00
5,000	70-ton	3,173.89	15,869,450.00
100,000		....	$289,453,450.00
Balance due on locomotives			$74,370,918.62
Balance due on cars			212,266,942.37
Total			$286,637,860.99

*These obligations become due as the equipment is delivered.

POSTERS TO ILLUSTRATE FIRING METHODS

The Fuel Conservation Section has prepared two colored posters showing the interior of a locomotive firebox for the purpose of illustrating the effects of irregular firing methods, to be posted in roundhouses, foremen's offices, Y. M. C. A. buildings and other places where they may readily come to the attention of railroad enginemen. The method of illustration was employed in the presentation of a paper by D. C. Buell on "The Proper Method of Firing Locomotives" at the fourth annual convention of the International Railway Fuel Association and was amplified and enlarged upon by the University of Illinois engineering experiment station in a circular from which the illustrations now used were taken.

SAFE HANDLING OF OXY-ACETYLENE APPARATUS IN SHOPS

Form I F-12 has been issued under date of February 15, by The Fire Loss and Protection Section in which are reproduced the recommendations and instructions for the safe handling of oxy-acetylene apparatus in shops contained in a paper * by E. Wanamaker, electrical engineer of the Rock Island Lines at the last annual meeting of the Railway Fire Protection Association. These recommendations have been approved by the Association and authorized to be issued as its Bulletin No. 17.

RENTAL CHARGES FOR DINING CARS, LOCOMOTIVE AND WRECKING CRANES

The director general has approved a schedule of rental charges to be applied between railroads for dining cars, locomotive cranes and various classes of work equipment, effective as of March 1. The following were taken from the list:

	Rate per day
Dining Cars: Furnished (except provisions)	$40.00
Locomotive Cranes:	
Five tons capacity or less	15.00
Over 5 tons capacity and less than 20 tons capacity	20.00
Over 20 tons capacity	25.00
Wrecking Cranes:	
Steam wrecking cranes, 75 tons capacity and less	40.00
Steam wrecking cranes, capacity more than 75 tons	55.00

ORDERS OF REGIONAL DIRECTORS

International Railway Fuel Association.—The regional director, Eastern region, by file 1301-28A584, advises that the director of the division of operation desires a large attendance of railroad fuel men at the International Railway Fuel Association's annual meeting, at Hotel Sherman, Chicago, May 19, 20, 21 and 22. The convention will discuss the conservation of railroad fuel coal, and railroad fuel men ought to attend regardless of whether or not they hold membership in the association. Federal managers are asked to see that their lines are properly represented, more particularly by men connected with the transportation and mechanical departments; such delegates to go prepared, as far as possible, to take an active part in the work of the convention. The Southern regional director, file 520-6, and the Northwestern director make the same request.

Lettering of Locomotives.—The Eastern and the Southwestern Regional Directors have announced that on locomotives ordered by the director general for individual roads, and which are paid for by the roads, the letters "U. S." need not be shown on the engines or tenders.

Rental Rate for Locomotives.—The regional director, Eastern region, by file 500-1-3A555, prescribes the rental rate for locomotives as one mill per pound of tractive power per day, with a minimum of fifteen dollars a day. This cancels the circular, file 3000-42, of March 12, 1918. The Northwestern, Southwestern and Southern regional directors have issued similar orders.

Report of Classified Locomotive Repairs.—The Southwestern regional director in Order 172 announces the adoption of Form MD-34 for uniform reports of locomotives receiving classification repairs. This report is mailed monthly to Frank McManamy, Washington, and a copy is sent to the regional director.

Liberal Motion Devices and Removable Driving Box Brasses.—In order to secure current data for the Committee of Standards relative to the performance of these two devices, the Eastern regional director, file 500-71A608, has issued blank forms calling for the number of locomotives equipped, date equipped, and maintenance costs per mile in each case, compared with an equal number of locomotives of the same class and in the same service not so equipped. For the lateral motion drive a comparison of flange wear is also

*For an abstract of Mr. Wanamaker's paper, see the *Railway Mechanical Engineer* for March, 1919, page 160.

called for and for the removable brasses, mileage between shoppings and cost of upkeep for brasses are required.

Failures of Mechanical Stokers.—The Southern regional director calls the attention of federal managers to numerous delays and failures of locomotives equipped with mechanical stokers, due to iron bolts, and other metallic substances, as well as rock and other foreign material, left in bottoms of coal cars. Instructions should be issued through purchasing department and fuel inspection forces to insure that empty cars shall be thoroughly cleaned before loading, and every effort must be made to prevent any metal substance being loaded with coal. Supervisors and foremen in charge of coaling stations must be instructed that special effort be made to eliminate foreign matter, destructive to stoker equipment, when coal is loaded on locomotives. The Eastern regional director, by file 500-1-54A585 issues similar orders, and Order 170, Southwestern region, covers the same subject.

Locomotive Dictionary and Master Car Builders' Dictionary.—A. H. Smith, regional director. Eastern region by file 500-88A583, advises that the director general has authorized a continuance by the railroads of past practice with respect to the furnishing of the Locomotive Dictionary and the Master Car Builders' Dictionary to their mechanical and purchasing officers. The Southern regional director, file 1701-2-6, issues the same notice.

Journal Box Packing.—The regional director of the Eastern region, by circular No. 500-13-14A540, advises federal managers that journal box packing for locomotives and cars may be bought under the individual roads' specification, the Railroad Administration specification R-94-A not being compulsory.

Freight cars; Cost Limit of Repairs.—Supplement 1 to Circular 23 of the Northwestern regional director, in complying with paragraph 8 of Division of Operation Circular 20, includes a model for the report of inspection and estimated cost of repairs to freight cars recommended for retirement or application of betterments and states that after cars are inspected and reported on this form the federal manager of the using road will transmit the original and two copies, with his recommendation, to the federal manager of the owning road, who will transmit one copy to the corporation, securing its approval; retain one copy and return the original to the federal manager of the using road, notifying him of the action taken.

Sheds for Protection of Car Repairers.—The regional director, Eastern region, by Circular No. 1800-133A567 calls for information concerning laws requiring the construction of sheds for this purpose. The director general has been asked by the brotherhood to adopt a policy and is anxious to pass upon the matter with as little delay as possible. Federal directors are asked to advise what States now have car shed laws, and their provisions; what railroads have adopted the policy generally of providing car sheds at the more important car repair points, and to recommend what the practice should be.

Sleeping Cars for Japanese Railways.—The Imperial Government Railways of Japan have designed a type of sleeping cars for third-class passengers which, according to the Railway Times of Tokyo, is an ordinary day coach, the seats of which are convertible into lower berths while the upper berths are attachable at night. On the upper beds, which are located along the direction of the car, passengers can sleep in the usual Japanese manner, and on the lower, which are located crosswise, they can lie on their sides and can stretch their feet. The fare will be about 1 yen (50 cents) per day, including the extra fare for the high-speed train. and it is hoped that fairly good rest may be enjoyed by third-class passengers, which is the most important class in local passenger traffic.

FUSE SIZES FOR SHOP MOTORS

The proper size of fuse for a motor is only too often obtained by haphazard methods. The motor's normal operating current is given by the maker on the name-plate, but fuses are properly selected of a larger capacity to allow for starting and for momentary overloads. Hence it is rather more unusual for the maintenance man to select his fuses "be guess and be gosh," with a view to their permanence in service rather than the safety of the motor they are supposed to protect.

In order to give a practical working idea of what sizes to use, the Westinghouse Electric & Manufacturing Company has prepared the accompanying tables. These are based on the following assumptions as to size of fuse required to stand starting current without blowing:

Type	Times fuse load current at starting
Polyphase wound rotor	1¼
Squirrel cage (thrown on line)	3
Single-phase repulsion induction with rheostat	2
Single-phase repulsion induction without rheostat	4
Direct current	1¼

Since the fuses for squirrel-cage and repulsion motors without rheostats are, respectively, rated 3 and 4 times full-load current, they give practically no overload protection. Hence it is recommended that double-throw switches be installed connecting the motor through fuses of 1.25 times full-load rating (as under wound rotor sizes) for running and through the regular heavier fuses or direct to the line for starting.

Direct Current Motors

Horse power	Fuse rating in amperes with different voltages: 115 volts	230 volts	550 volts	Horse power	Fuse rating in amperes with different voltages: 115 volts	230 volts	550 volts
1	10	5	3	12½	110	60	25
1½	15	8	3	15	125	70	30
2	20	10	5	20	175	90	35
2½	25	12	6	25	225	110	45
3	30	15	6	30	275	125	55
3½	35	15	6	35	325	150	65
5	50	25	10	40	350	175	75
6½	65	35	15	50	450	225	95
7½	70	35	15	60	550	..	110
8½	85	45	20	75	..	..	150
10	90	45	20	100	..	..	200
11	100	55	25				

Three-Phase Wound Rotor Induction Motors

Horse power	Fuse rating in amperes with different voltages: 220 volts	440 volts	550 volts
5	20	10	8
7½	30	15	12
10	40	20	15
15	50	25	20
20	70	35	30
25	85	40	35
30	100	50	40
35	125	60	50
40	150	70	60
50	175	80	65

Two-Phase Wound Rotor Induction Motors

Horse power	Fuse rating in amperes with different voltages: 220 volts	440 volts
5	20	8
7½	25	15
10	35	20
15	45	25
20	60	30
25	70	35
30	90	45
35	110	55
40	120	60
50	150	70

Three-Phase Squirrel Cage Motors

Horse power	Fuse rating in amperes with different voltages: 110 volts	220 volts	440 volts	550 volts
½	12	6	3	2
1	20	10	5	4
2	35	20	10	8
3	50	30	15	12
5	90	45	25	20

Two-Phase Squirrel Cage Motors

Horse power	Fuse rating in amperes with different voltages: 110 volts	220 volts	440 volts
½	10	6	3
1	20	10	5
2	35	15	10
3	45	25	15
5	80	40	20

Type AR Single Phase Motors

Horse power	Fuse rating in amperes with different voltages: Without rheostat, 110 volts	Without rheostat, 220 volts	With rheostat, 110 volts	With rheostat, 220 volts
2	80	40	40	20
3	120	60	60	30
5	200	100	100	55
7½	325	175	175	80
10	400	200	200	100
½	20	10	10	6
¾	30	15	15	8
1	40	20	20	10

The Resistance of Materials

The Effect of Sudden or Abrupt Changes In Section on the Distribution of the Unit Stresses

BY G. S. CHILES and R. G. KELLEY

II.

IN the common theory of beams we assume that the elongation or shortening per unit of length of any fibre is proportional to the distance of the fibre from the neutral axis of the cross-section, that is, that the stress distribution or intensity is linear.

Professor Croker found by experiment* (optical method) the distribution of stress in rectangular beams with holes cut through them. In the upper specimen of Fig. 7 the two-inch diameter hole is located at the center on the neutral axis, while in the lower specimen two one-inch holes were placed half-way between the upper and lower edges and the longitudinal center line.

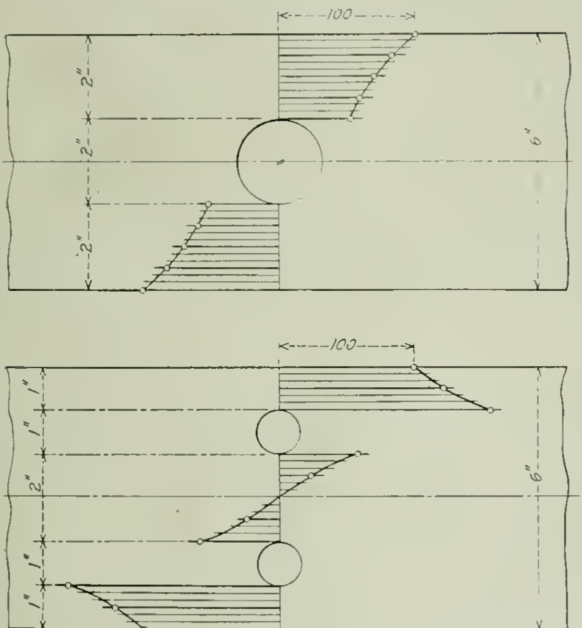


Fig. 7

The maximum stress in the beam having the central hole occurs at the outer edge of the beam but the stress intensity is not directly proportional to the distance from the neutral axis. At the outer edge of the hole, which is one-third the distance to the outer edge of the plate, the stress intensity if linear should equal one-third the value for the outer edge. Instead it is some 52 per cent of the value of the intensity at the outer edge, or some 57 per cent more than if it were linear.

The maximum stress in the beam having the two one-inch holes does not occur at the outer edge of the beam but at the outer edge of each hole. The intensity of the stress at the outer edge of the holes is 132 per cent more than it would be if directly proportional to the distance from the neutral axis and is some 55 per cent more than the stress at the outer edge of the beam. The stress at the inner edge of the holes is 74 per cent more than it would be if directly proportional to the distance out. The stress intensity at the outer edge was used in obtaining the proportional stress intensity in all cases.

It is evident that holes, especially those located near the outer edges of a beam, have a decided influence on the intensity of stress.

For additional information on the effect of holes in beams the reader is referred to a paper, "Some Important Points in the Design of a Box Bolster," delivered before the St. Louis Railway Club at the May, 1918, meeting, by Professor Louis E. Endsley, of the University of Pittsburgh.*

RESULTS FROM VIBRATORY TESTS AND ACTUAL SERVICE

For the purpose of determining the effect of abrupt changes of section in a few of the forms which are commonly used in machine design when subjected to the action of alternating stresses, Professor T. E. Stanton carried out a series of experiments† on the four forms whose contour and dimensions are illustrated in Fig. 8. The form *a* is that which offers the maximum resistance to the load and the values of its resistances will be considered to represent the maximum resistance of the material. The form *b* is a test piece of similar contour but having its center section threaded; the form *c* represents a piece having a moderately rapid change of section brought about by the use of fillets, while test piece *d* illustrates a form in which the change of section at the junction of the center section and shanks is abrupt due to the absence of fillets.

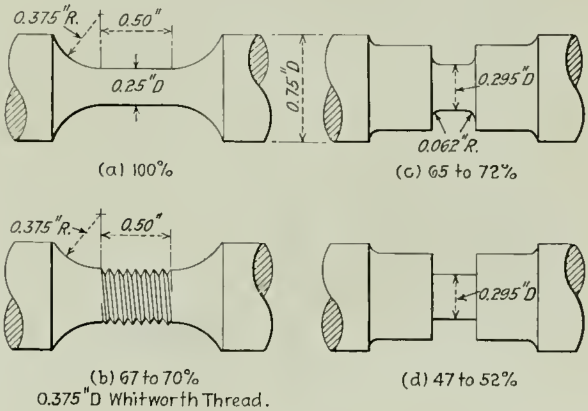


Fig. 8

The results of Professor Stanton's tests upon these four forms and four carbon percentages for each form are set forth graphically in the diagram, Fig. 9, the carbon content of the various test pieces being plotted as abscissae and the limiting range of stresses being plotted as ordinates. The curve *a* is the resistance curve of the section of maximum resistance designated by the corresponding letter in Fig. 8.

*See Engineering (London), March 3, 1912.

*See *Railway Mechanical Engineer* for June, 1918, page 343.

†See "A Factor in the Design of Machine Details," by T. E. Stanton, D. Sc., M. Inst. C. E., Engineering (London), April 19, 1907.

The curve *b* is the resistance curve of the threaded test specimen. It is evident that the resistance of a section which has been threaded has been reduced to a value ranging from 67 per cent to 70 per cent of the maximum resistance of the material.

Professor Stanton discusses the resistances of the screw threads as follows:

"The above resistances are, of course, estimated per unit of area, so that in calculating the strength of a screwed rod under alternating stress it will be further necessary to take into account the area at the bottom of the threads, so that the total reduction in resistance may well be more than 50 per cent of its maximum value.

"In the case of screw threads there is a further possible source of weakness due to faulty machining in the cutting of the screw. If the bottoms of the threads are not properly curved, (see Fig. 10 for enlarged section), but left with a sharp angle, there can be no doubt that risks of the development of a crack are very considerably increased. It seems quite probable that failures of steam-engine cross-head bolts, which have broken under very low range of stress, may be due to this cause. . . ."

The diameter at the root of the thread for the 3/8-in. screw

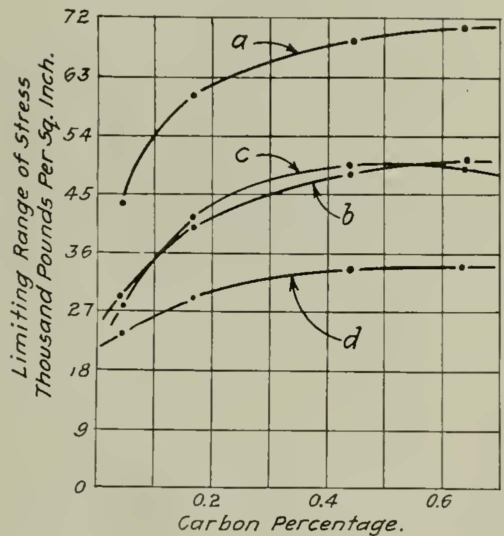


Fig. 9

is 0.2950 in. He obtained practically the same results for the resistance of the specimen having a gradual change of section when subjected to alternating stresses, as shown by the curve *c* which is the resistance curve of the section marked *c* in Fig 8. This curve indicates that the resistance of the section varies from 65 per cent to 72 per cent of the maximum resistance of the material as plotted in curve *a*. Finally, the resistance of section *d* was found to be from 47 per cent to 52 per cent of section *a*, Fig. 8. In regard to this curve, Professor Stanton directs especial attention to the fact that, while the maximum resistance of the test specimens of this form does not increase as the carbon content is increased in as great proportion as in the case of curves *a*, *b* and *c*, the resistance of the 0.4 and 0.6 carbon steels is about 40 per cent greater than that of the iron.

It is evident, therefore, that stress distribution is affected by any sudden change of section and the assumptions that the stress due to an axial load is uniformly distributed, or that a member subjected to bending has a linear distribution of stress from the neutral axis outward are not justified. For members not subjected to repeated or alternating stresses this would appear not to be especially serious. But in the case of members subject to dynamic action, the available information seems to indicate that extreme caution is necessary in members having abrupt sections, since any sudden change of section very greatly reduces the endurance of members subjected to a repetition of loading. Aside from service stress considerations the designer must give thought to the

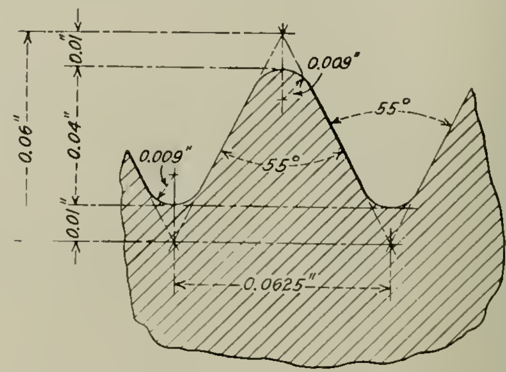


Fig. 10

manufacturing side, especially so in the case of heat treated parts.

EXPERIMENTS WITH RUBBER TEST SPECIMENS

In casting about, some time ago, for a suitable means to illustrate in a general way the results which might be expected from the effect of sudden or abrupt changes of section upon the distribution of stress the idea was hit upon to use models made of rubber. It was thought this would visualize

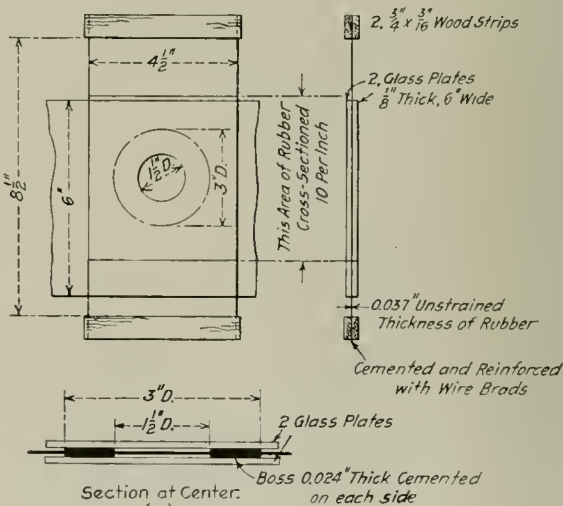


Fig. 11

the action and thus bring it more forcibly to the reader's attention.

The question may be raised as to whether or not there is any justification for comparing the action, under strain, of rubber with that of other materials more commonly used in engineering practice. In a recent investigation* for the purpose of determining Young's Modulus, which is the ratio of unit stress to unit strain or deformation, and Poisson's

*The Analysis of Finite Extensions and Elasticity of Rubber, Annalen der Physic, No. 21, 602, Nov., 1906.

Ratio, which is the ratio of lateral strain to longitudinal strain, (in the case of extension, the ratio of the elongation per unit of length to the contraction per unit of lateral dimension), O. Frank found it convenient to employ models consisting of a high grade of Para rubber. In this instance Mr. Frank used a test piece which was in the form of a strip 15.75 in. long, 3.94 in. wide and 0.016 in. thick and had fine lines about 3.15 in. apart ruled across it near its center when in a normal or unstrained condition. By measuring the distance between these ruled lines for each new extension of the strip up to a maximum extension of something less than 200 per cent, he obtained as the mean value of Poisson's ratio for rubber 0.46. Landolt and Börnstein (Physikalisch Tabellen) give, as the value of Poisson's ratio for rubber, 0.49.

For concrete, Poisson's ratio is from 0.1 to 0.13 and for the metals in general it ranges from 0.2 to 0.38, being from 0.25 to 0.33 for steel. As a preliminary to the experimental investigations which follow, tests were conducted upon a strip of rubber 1½ in. wide, ¼ in. thick and 14 in. long in order to determine the value of Poisson's ratio for the material. This was found to be approximately 0.33.

The rubber from which the models employed in the experiments covered by Figs. 12 to 15 inclusive were made was a high grade dental gum while that used for the experiments illustrated by Figs. 16 to 20 inclusive was a grade of ¼ in. rubber manufactured especially for the purpose.

A series of experiments was first conducted upon a number of rubber strips 4½ in. in width which were perforated with holes located as shown at *a*, *b* and *c* in Fig. 1. The diameter of the circular hole in the center of the strip indicated at *a* was 1½ in.; the diameter of each of the semicircular holes located on the outer edges at the midlength of the strip marked *b* was also 1½ in., while the square hole located at the center of the strip designated by *c* was 1½ in. square. The ends of the rubber bands were attached to small wooden strips (see Fig. 11) and while in an unstrained condition the rubber was ruled for a length of 5 inches with equally spaced horizontal and vertical lines of white show card ink, 10 lines to the inch, as shown in Fig. 12*a*. The dark ink lines which appear on the tracing cloth underneath the rubber, are for the purpose of comparison.

Fig. 12*b* shows the rubber strip when subjected to a pull of five pounds. In order to overcome the tendency of the rubber to buckle when in this condition, as is noticeable in the photograph, a glass plate was pressed lightly against either side of the rubber band as indicated in Fig. 12*c*, care being taken to apply to the plates an amount of pressure sufficient only to eliminate the tendency to buckle. The pressure was applied to the glass plates gradually while the pull was being applied thus allowing the rubber band freedom of movement and at the same time retarding the tendency toward buckling.

In Fig. 12*a* a part of the heavy black ink lines outlining the edge of the hole and the outer edge of the rubber strip are shown. In Fig. 12*b*, the hole in the rubber has decreased

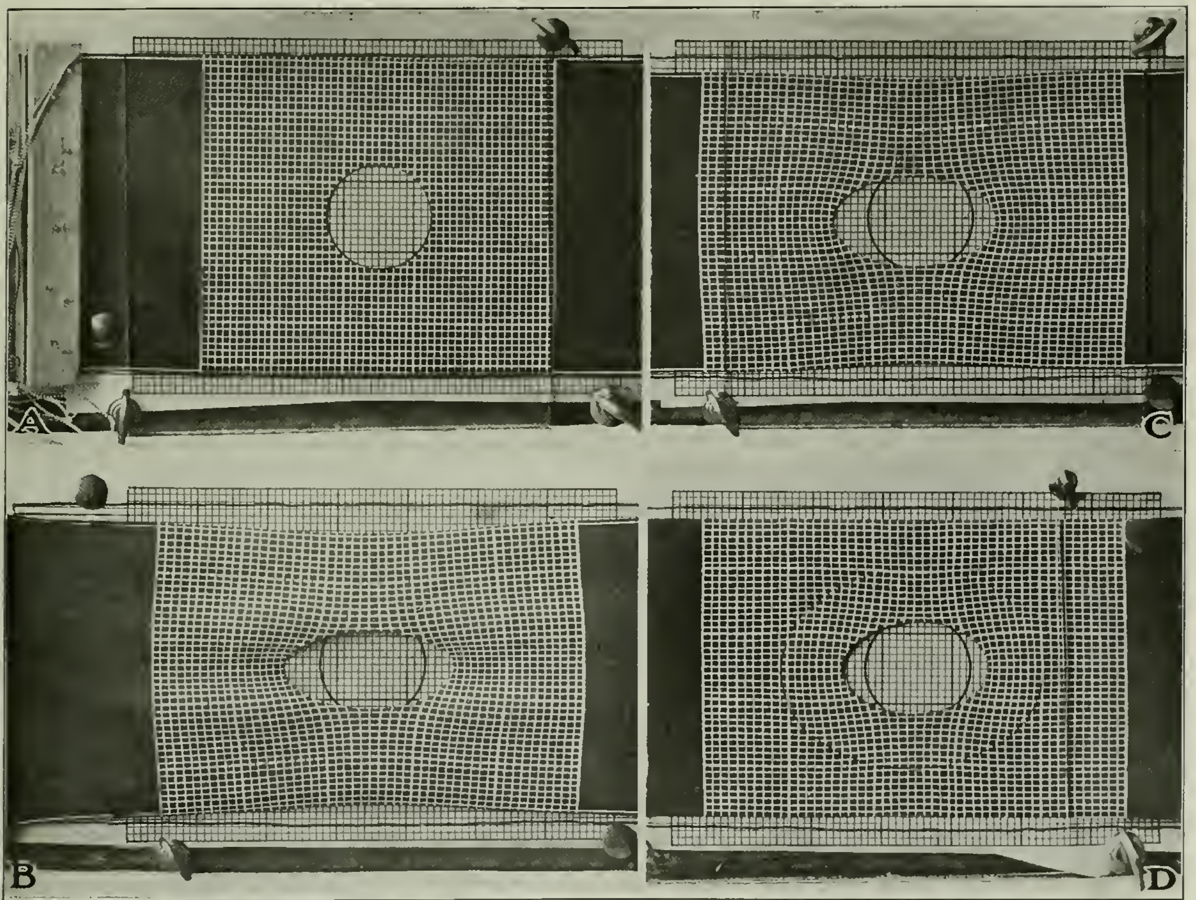


Fig. 12—The Effect of a Central Hole with and without Bosses, on the Stress Distribution in Sheet Rubber Under Tension

0.4 in. in width while the total width of the strip is about 0.7 in. less. After the glass pressure plates were applied the width of the hole decreased only about 0.2 while the total width of the strip was 0.5 in. less than in the unstrained condition. Thus the net width of the rubber through the center of the hole when given a five-pound pull was about 0.3 in. less when the glass plates were applied than it was in the unstrained condition.

That the rubber is strained relatively more near the inner edge of the hole is evident from the distance between the ruled white lines, at the side of the hole. At the ends of the hole the strained length is really less than the unstrained length, showing the rubber to be in compression at these points. The vertical and horizontal lines clearly visualize the action found and measured by the polarized light method as plotted in Fig. 3.

In discussing the stresses shown in Fig. 3, reference was made to the longitudinal stress f_t in the same direction as the pull and the radial stress f_{tr} of the stress at right angles to longitudinal stress. These stresses as well as those referred to in connection with Figs. 4, 5 and 6 are clearly illustrated by the action of the white ink lines on the rubber strips and by the eye bar of Fig. 16*b*.

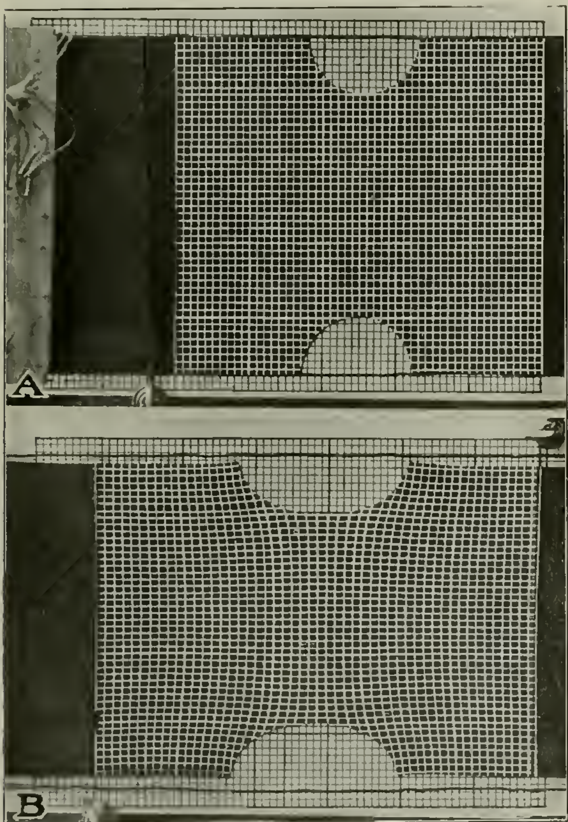


Fig. 13—Effect of Semi-circular Notches in Sides of Sheet Rubber Specimen Under Tension

The pictures of the rubber models in all the experiments showing the unstrained position were taken after the maximum strain position, the idea being to demonstrate that the models had not been given a permanent set, in other words, that the action was entirely elastic. The photograph shown in Fig. 12*a* was not taken until after the photographs of Fig. 12*b* and *c* had been taken.

Fig. 12*d* illustrates the strained condition of a strip of rubber subjected to a pull of five pounds which is alike in all respects to the strip of rubber shown in Fig. 11 except that a boss 0.024 in. thick was cemented on either side around the hole before the lines were ruled in. The location, size, etc., of the bosses are indicated by dotted lines in Fig. 11. The total cross-sectional area of the material immediately adjacent to the hole is now greater than that of the remaining portions, the total thickness of the bosses being 0.048 in. while the thickness of the rubber strip itself is 0.037 in. In this instance, the glass plates came in contact with the bosses only as indicated at *a* in Fig. 11. It is evident that the effect of the addition of the bosses has been to reduce the intensity of the stress, although the action is similar to that when no bosses were applied, the maximum stress near the edge of the hole is still greater than the average stress over the central section.

Fig. 13*a* represents a strip of rubber similar to that of Fig. 12 except that it is provided with semi-circular holes, each of which is equal in area to half of the hole in the original strip, located at either side of the strip on the same center line as shown at *b* in Fig. 1. The strip is shown in an unstrained position, ruled up in a similar manner, in contact (without pressure) with glass plates above and beneath, and resting, as in the preceding case, upon a strip of tracing cloth ruled with heavy black ink reference lines.

Fig. 13*b* illustrates the distribution of stress in this rubber strip, when subjected to a pull of five pounds and with the pressure plates in action as in the preceding cases. The resulting lines of distortion are very similar to the case illustrated in Fig. 12*c* where the hole was central.

(*To be concluded*)

One of the Engines Recently Surrendered to the French and Its Crew

The Atlantic City Conventions

Government and Program of June Meeting of Mechanical Section, American Railroad Association

THE American Railway Association has been reorganized as the American Railroad Association with five sections covering operating, engineering, mechanical, traffic and transportation. The mechanical section consists of the former American Railway Master Mechanics' Association and the Master Car Builders' Association, the work of which is now combined and co-ordinated with that of the similar organizations in other departments, through the parent organization.

Circular S-3, No. 1a has been issued by the American Railroad Association giving the personnel of the general committee which will be in charge of the convention at Atlantic City next June, together with the rules of order and a list of the committees which will report at the convention.

The general committee is made up as follows:

C. E. Chambers, mechanical assistant, Allegheny Region, chairman.
W. J. Tollerton, general mechanical superintedent, Rock Island Lines, vice-chairman.
Frank McManamy, assistant director, Division of Operation, U. S. R. A.
C. B. Young, manager, Inspection Test Section, Division of Operation, U. S. R. A.
F. F. Gaines, chairman, Board of Railway Wages and Working Conditions.
J. S. Downing, general master car builder, C. C. C. & St. L.
J. S. Lentz, master car builder, Lehigh Valley.
M. K. Barnum, assistant to general superintendent, maintenance of equipment, Baltimore & Ohio.
J. R. Gould, superintendent motive power, Chesapeake & Ohio.
A. Kearney, superintendent motive power, Norfolk & Western.
C. E. Fuller, superintendent motive power and machinery, Union Pacific.
T. H. Goodnow, superintendent car department, Chicago & North Western.
J. W. Small, mechanical assistant, Southern Region.
C. F. Giles, superintendent machinery, Louisville & Nashville.
J. E. O'Brien, mechanical superintendent, Missouri Pacific.
A. P. Prendergast, mechanical superintendent, International & Great Northern.
H. R. Warnock, general superintendent motive power, Chicago, Milwaukee & St. Paul.
James Coleman, superintendent car department, Grand Trunk.
W. H. Winterrowd, chief mechanical engineer, Canadian Pacific.

RULES OF ORDER

The following are the rules of order which will govern the conduct of the section:

1. (a) The membership of Section 3—Mechanical—shall consist of three classes: representative, affiliated and life.

(b) Representative members shall be those officials of railroads above the rank of general foreman having charge of the design, construction or repair of motive power or rolling stock, who shall be designated by the federal manager or executive official of the member of the association to serve in the section.

(c) Any person having such knowledge of science or practical experience in matters pertaining to the construction of motive power or rolling stock as would be of special value to the section may become an affiliated member on being recommended by three representative members. The name of such candidate shall then be referred to the general committee which shall report to the section on his fitness for such membership. He shall be elected by written or printed ballot at any regular meeting of the section held not less than six months after the candidate has been proposed and five dissenting votes shall reject. Affiliated members shall be entitled to all the privileges of representative members excepting that of voting and being elected to office in the section and may serve on committees on appointment by the general committee, in addition to the regularly elected members of such committee.

Such membership shall continue until written resignation is received by the secretary or the membership is terminated by the general committee or by the members becoming engaged in business which, in the judgment of the general committee would impair his usefulness to the section or discriminate against others, similarly engaged. Affiliated members shall not be subject to dues or assessments.

(d) Representative members who have been in good standing twenty years, or members who have served as chairman of the section may become candidates for life membership on the recommendation of the general committee. The names of such members shall be referred to the section in convention for election by written or printed ballot at any regular meeting of the section and five dissenting votes shall reject.

(e) Those persons, active or representative members, who have been in good standing in either the Master Car Builders' Association or the American Railway Master Mechanics' Association for twenty years, or members who have served as president of either association or as chairman of the section may also become candidates for life membership. Those now carried by the Master Car Builders' Association as life members or by the American Railway Master Mechanics' Association as honorary members will be continued as life members of Section Three—Mechanical.

2. (a) In addition to the chairman, vice-chairman and the general committee of the section, a nominating committee shall be elected.

(b) The general committee shall consist of sixteen elected members, including the chairman and the vice-chairman of the section, and, in addition, during the period of federal control, of three representatives of the United States Railroad Administration to be designated by the director of the Division of Operation. The elected members during federal control shall consist of two representatives from each region and two representing the Canadian railroads.

3. The duties of all officers shall be such as shall pertain to their offices or as may be delegated to them by the general committee of the section.

4. (a) The general committee shall exercise general supervision over the interests and affairs of the section, call, prepare for and conduct general conventions.

(b) The general committee shall exercise such supervision over the standards, recommended practice, or rules of this section as may be necessary to meet any emergency that may arise during the year in the conduct of the affairs of the section.

(c) It shall make a report at each convention which shall cover the action it has taken on such general or emergent supervision and make such recommendations as it may deem necessary on questions of importance to the section.

(d) The general committee shall select and appoint the members of the several standing committees and of such special committees as may be found necessary from time to time for conducting the business of the section and for investigating such matters as may be referred to the section or the committee may deem expedient to carry out the purpose of the section. It shall make appointments to the membership of any of the committees that may be necessary to fill any vacancies which may occur.

(e) The general committee shall receive, examine and approve before public reading all communications, papers and reports and it shall decide what portion of the reports, papers and drawings shall be submitted to each convention and what portion shall be printed in the annual report. It shall also determine which, if any, of the subjects presented at the convention or by members shall be referred to the executive committee of the association.

(f) The general committee shall offer to the convention the names of ten representative members not officers of the section as candidates for the committee on nominations.

(g) The general committee may call special meetings of the section to be held not less than thirty days after the notice thereof has been mailed to each member of the section.

(h) Nine members of the general committee shall constitute a quorum for the transaction of business.

5. (a) It shall be the duty of the committee on nominations to offer to the convention the name of one representative member as a candidate for chairman and one for vice-chairman, and the names of seven representative members as candidates for the general committee.

(b) When twenty or more members desire to propose the name of a member for any office, in addition to the names suggested by the committee on nominations, the secretary shall place the name or names of such persons for said office on the printed ballot, making a statement to the effect that such name or names has been proposed by a certain number of members.

6. (a) It shall be the duty of the secretary to issue a circular annually, intimating the date and place when and where candidates may be examined for the scholarships of the section.

(b) Acceptable candidates for the scholarship shall be first, sons of members or of deceased members of the section.

If there is not a sufficient number of such applicants for the June examination, then applications will be received from other railroad employees or the sons of other railroad employees for the fall examination. The secretary shall issue a proper circular in this case as before. In extending the privilege outside of the families of members, preference shall be given to employees or the sons of employees or the sons of deceased employees of the mechanical departments.

(c) Candidates for these scholarships shall apply to the secretary of this section and if found eligible shall be given a certificate to that effect for presentation to the school authorities. This will entitle the candidate to attend the preliminary examination. If more than one candidate passes the preliminary examination, the applicant passing the highest examination shall be entitled to the scholarship, the school authorities settling the question.

(d) The successful candidate shall be required to take a course prescribed by the general committee.

7. (a) The officers, excepting as otherwise herein provided, shall be elected at the regular meeting of the section held in June of each year and the election shall not be postponed except by unanimous consent.

(b) The chairman and the vice-chairman of the section shall be elected by written or printed ballots alternately every second year, the candidate receiving a majority of the votes cast shall be declared elected and shall hold office for two years or until his successor shall be elected.

(c) Members of the general committee and the committee on nominations shall be elected by written or printed ballots. Seven members of the general committee will be elected at each regular session to serve for two years. Five members of the committee on nominations will be elected annually.

(d) In the election of members of the general committee and the committee on nominations each representative member is entitled to one vote.

8. (a) At the first session of the annual meeting the report of the committee on nominations announcing the names of the nominees for officers and the general committee of the section shall be read. Elections shall not be held before the day after such announcement except by unanimous consent. Votes may be cast for any member eligible to serve as chairman, vice-chairman, members of general committee or members of committee on nominations by adding the name to the printed ballot.

(b) In all ballots for chairman, vice-chairman, members of general committee and committee on nominations or for affiliated or life members at the meetings of the section, the following form of voting shall be adhered to: An envelope shall be provided on which there shall be a blank space for the name of the railroad, and the name of the official voting; smaller envelopes shall be provided on which shall be printed the words "For Officers," "For Members General Committee," "For Members Committee on Nominations," "For Affiliated and Life Membership," and otherwise unmarked. In these envelopes the ballots shall be placed by those voting them and they shall then be placed within the larger envelope and presented to the general tellers. When a ballot is to be taken the chairman will announce the names of all required tellers. Three general tellers shall have charge of receiving and recording the ballots cast. When all ballots have been cast these tellers will announce that the polls are closed. They shall then remove the smaller envelopes, count and announce the vote for officers and shall deliver the envelopes marked "For General Committee" to two tellers, who shall count and announce to the general tellers the vote for general committee and those marked "For Committee on Nominations" to two tellers who shall count and announce to the general tellers the vote for the committee on nominations, and those marked "For Affiliated and Life Members" to two tellers who shall count and announce to the general tellers the vote for affiliated and life membership.

(c) The general tellers shall record and announce the total number of votes cast, the result of the vote, and shall be the judges of eligibility of any ballot presented.

(d) When a ballot for officers or membership on committees shall be announced as having eventuated in a tie vote, or be otherwise undecided, upon such announcement the final result shall be determined by the majority of the members present.

9. (a) Unless otherwise provided herein, a vote in the session of the section may be taken *viva voce*, by arising, or by written or printed ballot in any of which only representative members and representatives of the United States Railroad Administration shall participate. Letter ballots may be ordered to be taken in such manner and under such conditions as the section may by resolution from time to time or the general committee may direct.

(b) Printed ballots for use in the election of officers, members of the general committee and the committee on nominations, and for affiliated and life memberships to be of the form as prepared by the committee on nominations.

10. (a) At each annual meeting, the chairman shall appoint a committee on subjects whose duty it shall be to report at the next annual meeting subjects for investigation and discussion, and if the subjects are approved by the section, the general committee as hereinafter provided, shall appoint committees to report on them. It shall also be the duty of the committee on subjects to receive from members questions for discussion during the time set apart for that purpose. That commitee shall determine whether such questions are suitable ones for discussion, and if so, it shall report them to the section.

(b) When the committee on subjects has reported and the section approved of subjects for investigation, the general committee shall appoint individuals or special committees to investigate and report on any subject which a majority of the members present may approve; or individual papers may be presented to the section after approval by the general committee. Papers and reports shall be presented by abstracts, which shall not occupy more than ten minutes in the reading unless otherwise ordered by the section.

(c) Any proposition recommending the adoption of standard construction or practice shall be in writing and be accompanied by drawings, if the latter are necessary for a clear understanding of the subject. Such proposition shall then be submitted to the section for discussion, after which a vote shall be taken to decide whether the proposition shall be submitted for decision by letter ballot to all the members entitled to vote. If decided in the affirmative, the secretary within two months from the time the vote of the section is taken on such measure, shall send by mail to each member a blank ballot, and a copy of the proposed recommendation, with a report, to be approved by the general committee of the discussion thereon; such ballot to be returned to the secretary, who will count all the ballots received within thirty days from the date they were sent to the members, and he shall then announce the vote in such manner as the general committee may prescribe. Any recommendation securing two-thirds of the votes cast shall be adopted by the section.

(d) All reports, resolutions and recommendations involving the use, or proposed use, by railroads, of any device or process which forms the subject matter of any existing patent, shall first be submitted to the general committee, and shall be submitted to the section only by the general committee.

11. (a) The regular annual meeting of the section shall be held in June of each year. The dates of such meeting shall be fixed by the general committee.

(b) The regular hours of session shall be arranged by the general committee and published on the program for each meeting.

(c) The place for each annual meeting shall be fixed at least four months before the annual meeting by the general committee.

(d) At any regular meeting thirty or more members entitled to a vote shall constitute a quorum.

(e) The business of the meetings of the section shall, unless otherwise ordered by a vote, proceed in the following manner:

1. Address by the chairman.
2. Acting on the minutes of the last meeting.
3. Report of secretary.
4. Appointment of resolutions and other committees.
5. Unfinished business.
6. New business.
7. Reports of committees.
8. Reading and discussing questions propounded by members.
9. Routine and miscellaneous business.
10. Election of officers.
11. Adjournment.

12. The revision of the rules of interchange shall be the special order of business at 10:00 a. m. on the second day of each annual convention, unless otherwise ordered.

13. Unless otherwise ordered, the discussion of questions proposed by members shall be the special order at 12:00 noon of each day of the annual meeting.

14. The votes of a majority of the members present shall be required to decide any question, motion or resolution which shall come before the section, unless otherwise ordered. Matters upon which authoritative action is required after approval by the section shall be submitted to the executive committee of the association, through the general secretary.

15. (a) The reports of all committees must be in the office of the secretary not later than April 1 in order that the same can be printed and advance copies issued 30 days prior to the opening date of the convention.

(b) Committee reports which do not reach the secretary as provided for in paragraph (a) will be referred to the general committee to decide whether the report shall be submitted to the convention.

(c) An abstract of the report of each committee will be read to the convention, together with whatever additional data may have been accumulated after the publication of the reports.

(d) The members of committees who may individually or collectively submit a minority report must prepare the same so that it can be issued with the report of the majority to substitute for the majority report in the event the section shall so decide.

(e) Each member of a committee must approve either the majority or a minority report.

16. These rules of order may be amended at any regular meeting by a two-thirds vote of the members present provided that written notice of the proposed amendment has been given by the general committee at least four months before.

REPORTS OF COMMITTEES

Thirty-one committees will report at the convention. The first 20, ordinarily considered as Master Car Builders' committees, will report from June 18 to June 20, and 11 committees which would be considered strictly as committees of the Master Mechanics' Association will report from the period of June 23 to June 25. The election of officers will take place on Saturday, June 21. The list of committees is as follows:

June 18-20, 1919, Inclusive.

1. Arbitration, J. J. Hennessey (C. M. & St. P.), chairman.
2. Standards and Recommended Practice (M. C. B.), T. H. Goodnow (C. & N. W.), chairman.
3. Train Brake and Signal Equipment, T. L. Burton (N. Y. C.), chairman.
4. Brake Shoes and Brake Beam Equipment, B. B. Milner (N. Y. C.), chairman.
5. Couplers, R. L. Kleine (Pennsylvania), chairman.
6. Loading Rules, J. J. Burch (N. & W.), chairman.
7. Car Wheels, W. C. A. Henry (Pennsylvania Lines West), chairman.
8. Safety Appliances, C. E. Chambers (U. S. R. A.), chairman.
9. Car Construction, W. F. Keisel (Pennsylvania), chairman.
10. Specifications and Tests for Materials (M. C. B.), F. M. Waring (Pennsylvania), chairman.
11. Car Trucks, J. T. Wallis (Pennsylvania), chairman.
12. Prices for Labor and Material, P. F. Smith, Jr. (Pennsylvania Lines West), chairman.
13. Train Lighting and Equipment, J. R. Sloan (Pennsylvania), chairman.
14. Nominations, F. W. Brazier (N. Y. C.), chairman.
15. Tank Cars, A. W. Gibbs (Pennsylvania), chairman.
16. Draft Gears, R. L. Kleine (Pennsylvania), chairman.
17. Welding Truck Side Frames, Bolsters and Arch Bars, W. O. Thompson (N. Y. C.), chairman.
18. Standard Blocking for Cradles of Car Dumping Machines, James McMullen (Erie), chairman.
19. Revision of Passenger Car Rules of Interchange, H. H. Harvey (C. B. & Q.), chairman.
20. Depreciation for Freight Cars, M. K. Barnum (B. & O.), chairman.

June 23-25, 1919, Inclusive.

21. Standards and Recommended Practice (A. R. M. M.), W. E. Dunham (C. & N. W.), chairman.
22. Mechanical Stokers, A. Kearney (N. & W.), chairman.
23. Fuel Economy and Smoke Prevention, William Schlafge (Erie), chairman.

24. Powdered Coal, C. H. Hogan (N. Y. C.), chairman.
25. Specifications and Tests for Materials (A. R. M. M.), F. M. Waring (Pennsylvania), chairman.
26. Design and Maintenance of Locomotive Boilers, C. E. Fuller (Union Pacific), chairman.
27. Locomotive Headlights, H. T. Bentley (C. & N. W.), chairman.
28. Superheater Locomotives, W. J. Tollerton (C. R. I. & P.), chairman.
29. Design, Maintenance and Operation of Electric Rolling Stock, C. H. Quereau (N. Y. C.), chairman.
30. Train Resistance and Tonnage Rating, O. P. Reese (Pennsylvania Lines West), chairman.
31. Subjects, M. K. Barnum (B. & O.), chairman.

Standard 2-8-8-2 Type Locomotives

First of Government Order for Over 100 of These Engines Delivered to the Norfolk & Western

The first order of 1,025 locomotives placed by the United States Railroad Administration included an order of 20 heavy (2-8-8-2) standard Mallets. This was later increased to over 100, 65 to be built by the American Locomotive Company and 41 by the Baldwin Locomotive Works. The American Locomotive Company has within the past month made the first delivery of these locomotives. While they were scheduled and lettered for the Virginian Railway they have been assigned for duty on the Norfolk & Western. These engines are the largest of the standard locomotives built for the Railroad Administration and represent the limit to which a locomotive can be built to come within the maximum clearance limitations set by the Railroad Administration (15 ft. 9 in. high and 10 ft. 9 in. over cylinders). These locomotives are smaller than those which can be used on the Virginian Railway, as evidenced by the 2-10-10-2 type Mallet locomotives which were recently built for that road by the American Locomotive Company. These latter engines have a width clearance of 12 ft. and a height clearance of 16 ft. 7½ in. On the other hand, the clearance limitations of these standard engines compare very favorably with the 2-8-8-2 Mallets recently built by the Norfolk & Western to that company's own design. Being limited by these clearance restrictions a very careful design had to be made to provide a locomotive of the power required.

In the matter of power these standard engines may be compared with locomotives of similar wheel arrangement built by the Norfolk & Western in its own shops, and for the Western Maryland by the Lima Locomotive Company. A table comparing the principal dimensions of these two locomotives is included. A description of the Norfolk & Western locomotive was published in the *Railway Mechanical Engineer* of August, 1918, page 445. From this table of comparison it will be seen that the standard locomotive is 6,000 lb. heavier than that built by the Norfolk & Western, and 3,300 lb. heavier than that built for the Western Maryland. The working pressure on the standard locomotive is also 10 lb. greater than that of the Norfolk & Western locomotive and 30 lb. higher than that used on the Western Maryland locomotive. The boiler proportions of the standard locomotive and those of the Norfolk & Western compare very favorably. However, the Norfolk & Western design provides about 200 sq. ft. more heating surface and about 35 sq. ft. greater superheating surface. While these two engines are very nearly alike in proportions, they are of an entirely different class as far as the construction details are concerned, which will necessitate a different line of repair parts and illustrates one of chief objections to standardization.

Table of Comparison of 2-8-8-2 Type Locomotives

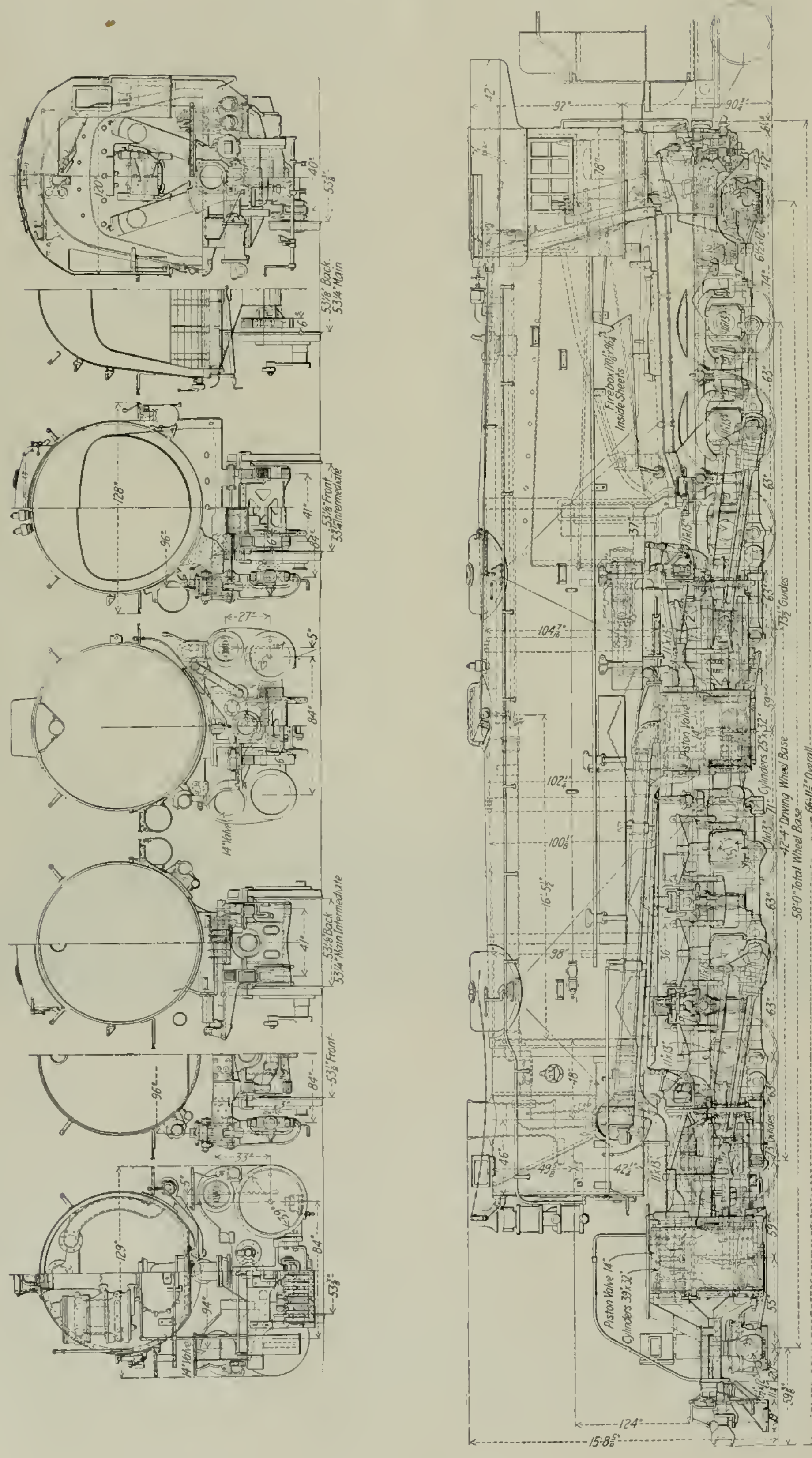
Name of road	U. S. Std.	Norfolk & Western	Western Maryland
When built	1919	1918	1915
Tractive effort, compound, lb.	106,000	104,300	106,000
Weight, total, lb.	531,000	535,000	495,000
Weight on drivers, lb.	57	56	52
Diameter of drivers, in.	478,000	472,000	445,000
Cylinders, diameter and stroke, in.	25 and 39 by 32	24½ and 38 by 32	26 and 40 by 30
Steam pressure, lb., per sq. in.	240	230	210
Total heating surface, sq. ft.	6,120	6,316	5,669
Superheater heating surface, sq. ft.	1,475	1,510	1,264
Grate area, sq. ft.	†96	96	80
Weight on drivers ÷ tractive effort (compound)	4.7	4.5	4.2
Tractive effort × diameter drivers ÷ equivalent heating surface*	695.	680.6	726.3
Equivalent heating surface* ÷ grate area	86.6	89.4	94.9

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.
†Gaines combustion chamber is used on this locomotive.

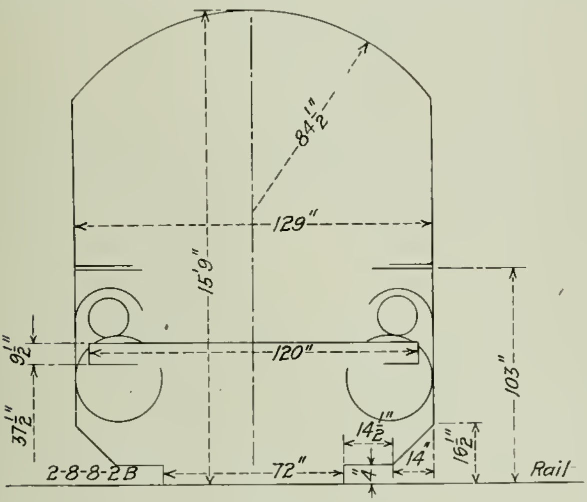
Standard 2-8-8-2 Type Locomotive for the U. S. Railroad Administration

The standard 2-8-8-2 Mallet locomotive has a total engine weight of 531,000 lb., of which 28,000 lb. is on the leading truck, 237,000 lb. on the front or low pressure unit, 241,000 lb. on the high pressure unit and 25,000 lb. on the trailing truck. It is built for a permissible axle load of 60,000 lb., which is the same limit prescribed for the standard 2-6-6-2 locomotive. The cylinders are 25 in. and 39 in. by 32 in., and a working pressure of 240 lb. is carried on the boiler. The distribution of the weights amongst the various drivers is shown in the weight diagram, which was prepared by F. P. Pfahler, chief mechanical engineer of the Mechanical Department, United States Railroad Administration. The clearance diagram, also prepared by Mr. Pfahler, is included in the illustrations.

The boiler of these locomotives has an outside diameter



Elevation and Sections of the Standard Heavy Mallet Type Locomotive at the first ring of 98 in. It is of the straight barrel type and has shell plates 1 1/16 in. thick. The dome is located on the third course and on account of the clearance limitation is only nine inches high. The boiler is equipped with a Gaines combustion chamber. The length of tubes is 24 ft. There are 274 2¼-in. tubes and 53 5½-in. flues, which are of No. 8 gage, being one gage heavier than the general standard practice in the construction of Mallet locomotives, due to the fact that a working pressure of 240 lb. is carried on the boiler. The firebox is 170⅛ in. by 96¼ in., having an effective grate area of 96.2 sq. ft. The firebox sheets are ⅜ in. thick and the back tube sheet is ½ in. thick. The tube



Clearance Diagram

spacing is similar to that used on the standard 2-6-6-2 type Mallets.

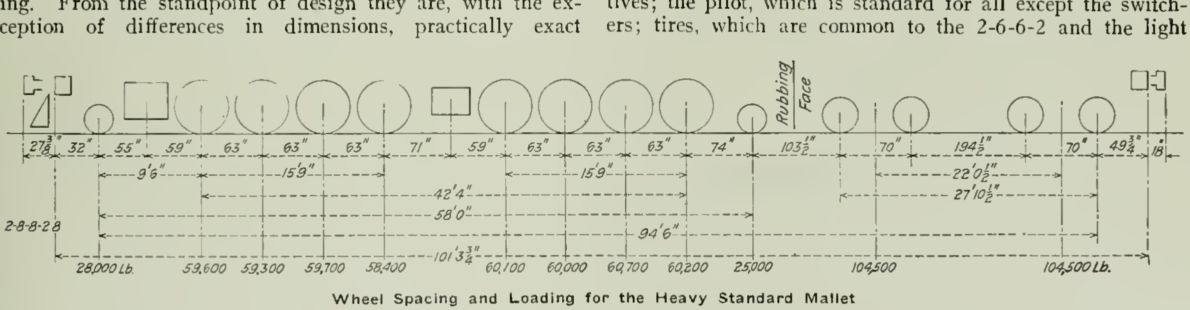
The frames for these locomotives are 6 in. in width, the same as for the 2-6-6-2 locomotives and are 6¾ in. deep over the pedestals, having a minimum thickness of 5½ in. The lower rails are 4½ in. deep, with a minimum thickness of 4 in. The frames for the high and low pressure engines are connected with the Baldwin type of frame hinged casting. From the standpoint of design they are, with the exception of differences in dimensions, practically exact

locomotives the valves and cylinders are bushed with Hunt-Spiller gun iron. Both cylinders are spaced 84 in. between centers, whereas in the lighter Mallets the spacing is 85 in. As in the case of the 2-6-6-2 Mallet the Mellin type of by-pass and intercepting valve is used to control the simpling and compounding of the locomotive.

In the matter of general design the crosshead for the 2-8-8-2 locomotive is the same as that of all standard locomotives. The dimensions are also practically the same, with the exception of the piston fit, the diameter of the boss in the body of the crosshead being made eight inches instead of seven, on account of the heavier piston rod, which is 4½ in. in diameter for the 2-8-8-2 locomotive and 3¾ in. in diameter for the 2-6-6-2 locomotive. The pistons have a dished section and those for the high pressure cylinders are interchangeable with those used on the light standard Pacific and the eight-wheel switchers. The specifications require that they be made of rolled steel or cast steel. They are provided with packing rings of Hunt-Spiller gun iron. The pistons for the low pressure cylinders are, of course, not interchangeable with any others used on the standard locomotives, although they are of the same general standard design. They are made of cast steel and are of dished section, having, as in the case of the high pressure cylinders, two packing rings of Hunt-Spiller gun iron. The piston rods for both the high and low pressure units of the heavy Mallet type locomotive are 4½ in. in diameter. Paxton-Mitchell piston and valve rod packing is used on these locomotives.

The main rods of both the high and low pressure cylinders are precisely the same. They are 118 in. long from center to center and are of I-section, being 3 in. wide and 6 in. deep, with 1½-in. flanges and a ½-in. web. They are of the same design as the main rods used on the 2-6-6-2 standard locomotive, the only difference being that they are one inch longer between centers and the flange is ½ in. deeper. Thus it will be seen that rods for both these locomotives can be manufactured from exactly the same size of stock material. The design of the strap end is exactly the same, the only difference being that the rods for the 2-8-8-2 type are a little heavier than for the 2-6-6-2 type locomotive.

Among the interchangeable details of these locomotives may be mentioned the dump grate rigging, which is the same as that used on the light and heavy Santa Fe locomotives; the pilot, which is standard for all except the switchers; tires, which are common to the 2-6-6-2 and the light



Wheel Spacing and Loading for the Heavy Standard Mallet

duplicates of the frames built for the standard 2-6-6-2 locomotive.

As in the case of the 2-6-6-2 standard locomotive, both the high and low pressure cylinders are provided with piston valves. A larger diameter of valve is used, however, it being 14 in. The travel of the valve for the high pressure cylinders is 6½ in. and it is given a lap of 1 in., a lead of ⅛ in. and an exhaust clearance of ¼ in. In the low pressure cylinders the valve is double ported and has a travel of 6 in. with a lap of 1⅛ in., a lead of 3/16 in. and an exhaust clearance of 7/16 in. As in the case of all the standard

Santa Fe; and engine truck and trailer axles, which are common to all of the standard locomotives. The engine truck box is the same as that used on both designs of Mikado and Santa Fe and the 2-6-6-2. The front bumper is the same as that used on all except the switchers and the frame pedestal shoe, wedge, and wedge bolt are the same on all locomotives except the switchers. In addition to this there are many other details which are interchangeable with the 2-6-6-2 type.

The specialties used on these locomotives as well as on the other standard engines were enumerated on page 137 of the March, 1919, issue of the *Railway Mechanical Engineer.*

The following is a list of the general dimensions of these locomotives with the principal data:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort (compound)	101,300 lb.
Tractive effort (simple)	121,600 lb.
Weight in working order	531,000 lb.
Weight on drivers	478,000 lb.
Weight on leading truck	28,000 lb.
Weight on trailing truck	25,000 lb.
Weight of engine and tender in working order	740,100 lb.
Wheel base, driving	42 ft. 1 in.
Wheel base, rigid	15 ft. 6 in.
Wheel base, total	57 ft. 4 in.
Wheel base, engine and tender	93 ft. 3 in.

Ratios

Weight on drivers ÷ tractive effort (simple)	3.93
Total weight ÷ tractive effort (simple)	4.37
Tractive effort (compound) × diam. drivers ÷ equivalent heating surface*	695.0
Equivalent heating surface* ÷ grate area	86.6
Firebox heating surface ÷ equivalent heating surface,* per cent	5.2
Weight on drivers ÷ equivalent heating surface*	57.5
Total weight ÷ equivalent heating surface*	63.8
Volume equivalent, simple cylinders, cu. ft	22.2
Equivalent heating surface* ÷ vol. cylinders	375.0
Grate area ÷ vol. cylinders	4.33

Cylinders

Kind	Compound
Diameter and stroke	25 in. and 39 in. by 32 in.

Valves

Kind	Piston
Diameter	14 in.

Wheels

Driving, diameter over tires	57 in.
Driving journals, diameter and length	11 in. by 13 in.
Engine truck wheels, diameter	30 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	30 in.
Trailing truck, journals	6½ in. by 12 in.

Boiler

Style	Straight top
Working pressure	240 lb. per sq. in.
Outside diameter of first ring	98 in.
Firebox, length and width	170⅛ in. by 96¼ in.
Firebox plates, thickness	⅜ in.
Firebox, water space	5 in.
Tubes, number and outside diameter	274—2¼ in.
Flues, number and outside diameter	53—5½ in.
Tubes and flues, length	24 ft.
Heating surface, tubes	3,860 sq. ft.
Heating surface, flues	1,825 sq. ft.
Heating surface, firebox	435 sq. ft.
Heating surface, total	6,120 sq. ft.
Superheater heating surface	1,475 sq. ft.
Equivalent heating surface*	8,333 sq. ft.
Grate area (with Gaines wall)	96 sq. ft.
Smokestack, height above rail	15 ft. 8⅝ in.
Center of boiler above rail	10 ft. 4 in.

Tender

Tank	Water bottom
Frame	Cast steel
Weight	209,100 lb.
Wheels, diameter	33 in.
Water capacity	12,000 gal.
Coal capacity	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

CO-OPERATION

BY FRANK McMANAMY
Assistant Director, Division of Operations, U. S. Railroad Administration

It has been generally understood that the government assumed control of the railroads because of the necessity of increasing their efficiency and operating them in such a manner that the necessary transportation would be provided to enable the country to successfully conduct the war against what had come to be recognized as the enemy of civilization.

It had been demonstrated that under individual control it was not possible to obtain the degree of co-operation necessary to bring about the increased efficiency which must be obtained and that only by operating the railroads as a single system under the direction of a strong central organization could the transportation needs of the country be met.

A survey of the situation showed that one of the principal, if not the principal, needs was to improve the condition of motive power and rolling stock.

Greater efficiency in this respect could only be secured by greater efforts and closer co-operation of the army of the railroad shop employees, because with the urgent demands for men for military service and for munition factories it was not possible to increase the forces in proportion to the increased work. The results of the past year show that increased efforts and better co-operation was secured to an extent hitherto unknown. Personal convenience and comfort on the part of railroad officials and employees were alike disregarded. Sundays, holidays and vacations were unknown to most of the railroad workers for the past year or more. Every loyal man was on the job 24 hours a day and seven days a week, or as near it as was physically possible. Employees' contracts were temporarily modified with respect to shop hours and to promotions and suggestions or requests of the Railroad Administration for changes that would increase efficiency and bring about closer co-operation have been cheerfully and promptly complied with. As a result of this it is not an exaggeration to say that a degree of efficiency in operating railroad shops was reached which has never before been attained. The railroad machine has been operated at high speed and with full tonnage and the shop employees have provided the necessary equipment.

In the matter of furnishing necessary equipment to conduct transportation during the war, the railroad shop employees have gone over the top and when the records of what they have accomplished is written they will have little to regret and much to be proud of.

The war is now over and the problems incident thereto are things of the past. We have, however, confronting us problems equally important if perhaps not so urgent.

The principal requirements necessary to go from a peace basis to a war basis were, unlimited energy and unceasing effort. To change the shop organization from a war basis to a peace basis, which is the task that confronts us now, will require unlimited patience, tact and judgment. A degree of co-operation equal to that which has been exercised during the war will be required. It will require the principle of the square deal to be recognized and observed on all sides and it will require absolute confidence that the necessary reorganization will be worked out with fairness.

The railroad shop employees with the co-operation of the officials, have performed a great service in their work during the past year, but it could not have been accomplished without complete co-operation and confidence in those who were directing the work. They have before them during the reconstruction or reorganization period an opportunity of performing an equally great service and if that is to be successfully performed it will require the co-operation of all and the work must be done in a way that will inspire confidence.

During war times two points in the operation of railroads predominated; namely, safety and efficiency, and others where they in any way adversely affected these could in a measure be disregarded. In times of peace safe and efficient service must be rendered to the public at a cost commensurate with the service performed. This, of course, means readjustments of hours and reorganization of forces, but this can and should be done along reasonable lines with proper consideration for the rights of the public and of the employees. If approached in the proper spirit and carried out with absolute fairness, necessary readjustments can be made without friction and without loss of efficiency.

The spirit of co-operation and the desire for performing constructive work which has been manifest during the past year is a sufficient guarantee that this will be done.

SWEEPINGS FROM SHOPS.—Attention has often been called to the importance of combing the sweepings which are hauled from the various shops, roundhouses, storehouses, etc., to the refuse car and taken out along the line and dumped. Yet there is reason to believe that there is much waste bound to accrue from lax methods in caring for the sweepings and an occasional inspection and renewal of instructions is worth while.—*Railway Storekeeper.*

MAINTENANCE OF FREIGHT EQUIPMENT*

BY H. L. SHIPMAN
Equipment Inspector, A. T. & S. F.

During the past year the maintenance of freight cars has been influenced by new conditions, due to the general pooling of equipment. This change is particularly noticeable in the box car. Formerly there was a normal percentage of from 35 per cent to 40 per cent of the box cars on the home lines. At the present time this percentage has fallen as low as 7 per cent to 12 per cent. Thus each road has less control over the maintenance standard of its own equipment. It would seem that some standard of maintenance should be established and all roads compelled to keep all freight cars on their lines up to that standard. This percentage should undoubtedly be higher than the standard now maintained by many of the smaller railroads, but some method should be devised to force all roads to come up to this standard. Unless this is done, under present conditions, the average standard of all cars will fall lower. and those roads, which under normal conditions would maintain this standard, will be helpless to keep it up.

There is a limit to the maintenance of equipment beyond which it is not practical or economical to go. If it were possible to maintain all freight equipment in 100 per cent condition, it would not be economical because there are many commodities that can be handled just as efficiently and satisfactorily in a car in fair condition as in one in 100 per cent condition. Since all cars in service are continually wearing out, or deteriorating, all that can be hoped for is to maintain in good condition a sufficient number of cars to handle the commodities that require a first-class car.

There are certain kinds of freight that require a box car, others a refrigerator, stock car, tank car or gondola and other freight may be handled just as well in several of the different kinds of freight cars. Some ladings require the cars to be in first-class condition and others only in fair condition. For example, a box car to handle grain, flour, sugar, or groceries, should be in the best condition possible. The siding must be tight, the roof non-leaking, and the floor and lining level and smooth, so as not to chafe or injure the contents. Wool, raw cotton, hay, brick, etc., may be handled in a car in fair condition without damage. A leaky roof or open siding will not injure these articles, and they cannot fall through cracks in the floor as would bulk grain. The only essential for cars handling the last mentioned articles is that the frame work of the car be strong enough to hold the load and that the trucks and draft gear be in good condition.

A refrigerator car must always be in good condition in order to protect its lading, due to the fact that the requirements of this service are very rigid. A stock car should be in good condition in order to handle live stock without damage, but the same car in fair condition will haul barreled goods, rough lumber, ties, lump coal, and many other articles, very satisfactorily. A gondola must be in very good condition to hold slack coal without loss, but will hold lump, coal, coke, scrap iron, etc., if in only fair condition.

On a typical western road there was a total of 1,240,324 car loads of revenue freight handled during the year 1917. This freight was subdivided under five general headings, namely, Products of Agriculture, Products of Animals, Products of Mines, Products of Forests, and Manufactured and Miscellaneous Articles. The number of car loads of each of these classes of freight was as follows:

Products of agriculture	298,717
Products of animals	172,836
Products of mines	385,836
Products of forests	99,301
Manufactured and miscellaneous articles	283,634

A close analysis of this freight as a whole shows that 72.6 per cent should be handled in cars of first-class condition in order to avoid possible loss or damage due to the condition of the cars; 27.4 per cent of the freight could be handled just as satisfactorily in cars of fair condition.

An extended investigation in the train yard and in a large repair shop of the causes of repairs to freight cars disclosed the fact that only a very small percentage of freight car repairs become necessary due to "time and the elements," or, in other words, rust and decay. To make this study, the repairs to freight cars were subdivided into four general headings representing the principal parts of the car, as body, draft gear, truck and air brake repairs. The investigation showed that most of the repairs required by the bodies of these cars became necessary due to time and the elements, and the next important cause of repairs in the body was starting, stopping and switching or load shift under shock. The draft gear and truck repairs became necessary chiefly due to the starting, stopping and switching of the car. Load shift causes the ends of the car to be pushed out, and posts broken and the siding and lining broken. A very small percentage of the repairs to draft gear or trucks was necessitated by time and the elements. Nearly all of the repairs to draft gear were caused by starting, stopping and switching. The draft gear is broken or weakened by shock in switching and the trucks need repairs because of stopping, as well as shock. The items of the greatest expense in truck repairs are brake shoes, brasses and wheels. It is very seldom a truck has a broken side frame or bolster. The air brakes need repairs because of running and stopping the car.

Combining the causes of repairs of the several parts of the car, the results showed that 47.2 per cent of the repairs to cars became necessary due to the running of the car, and time and the elements; 52.8 per cent of repairs to cars was necessitated by starting, stopping and switching, and the loading and unloading of the car. The 52.8 per cent in starting, stopping and switching and loading and unloading should be again subdivided to show the repairs due to the necessary wear of starting, stopping and switching and the unnecessary wear or abuse of the car. The subdivision shows that 33 per cent of the repairs would be eliminated if no draft gear, end sills, posts, siding or lining were broken by shock and no wheels slid flat or journal cut.

The next question to be considered is what percentage of

*From a paper presented before the Western Railway Club.

the freight equipment can economically be maintained in first-class condition. As mentioned above, 72.6 per cent of the freight equipment should be in first-class condition to carry the freight of this trunk line without damage or loss due to the condition of equipment. Is it feasible or practical to maintain this percentage as a standard of condition?

In a recent survey of bad order cars on several of our Western roads, it developed that the higher the percentage of revenue cars bad order on any line, the more men were employed per 1,000 revenue cars on the line, and the greater was the percentage of revenue cars that were repaired each month. Conversely, the lower the percentage of revenue cars bad order on the line, the smaller was the percentage of cars repaired each month. Comparing four of these roads, and averaging two of the higher and two of lower percentages, the results were as follows:

	Per cent of revenue cars, bad order	Per cent of cars repaired to revenue cars on line per month	Number car men employed per 1,000 rev. cars on line	Total number cars repaired per month	Number revenue cars on the line
Two higher ..	8.4 per cent	135.4 per cent	76.8	53,248	43,303
Two lower ...	3.0 per cent	59.4 per cent	37.7	25,909	37,443

Very few roads have a very high percentage of their own cars on their line. The freight car is common property today, therefore, it cannot be supposed that there is any very great difference in the physical condition of the cars on these four roads. These figures simply mean that different roads have different standards of maintenance, and that a road with a high standard will endeavor to keep the condition of freight equipment to a higher standard than the other road. In order to accomplish this end, the one road hires more men and consequently bad orders and repairs more cars than the other. These roads with the high standards of maintenance have found that the old saying "a stitch in time saves nine" is just as true when applied to a freight car as in its original application, and that the net results will show up on the credit side of the balance sheet.

A road with a high standard will cut down train delays and damage claims due to defective equipment, and as a result will pay a greater dividend than the road with the low standard of maintenance. A shipper prefers a road with a high standard of maintenance because he knows his products will receive better attention than on a road with low standards. There will not be the delays en route and the goods will arrive in better condition.

One step toward distributing repair work among all railroads so as to overcome the present practice of one road making only light repairs and another doing the substantial work, would be to have a standard classification of repairs. This would make it easier to judge work done and the output. I would recommend the following outline as a reasonable classification for the subdivision of repairs:

Classifications of Repairs to Freight and Work Cars

Heavy Repairs

One or two pair draft timbers.
Two or more sills renewed or spliced.
One or two end sills.
Two or more side or door posts.
One-half or more outside sheathing renewed.
Entire roof relaid or renewed.
Flooring renewed or repaired.
Door rehung or new doors applied.
Car trussed up and body tightened.
Two trucks given general overhauling.
Cars repainted and stenciled.
(Any seven or more of above items constitute heavy repairs.)

Medium Repairs

One or two pair draft timbers.
One end sill or new end and siding.
One pair draw sills spliced.
Roof relaid or new roof applied.
Door rehung or new door applied.
Trucks repaired.
Cars trussed.
All new work painted.
(Any five or more of above items constitute medium repairs.)

Running Repairs

Uncoupling attachments repaired.
Grab iron renewed or repaired.
Brasses applied.
Brake shoes renewed.
Running boards repaired.
Brake connection and lever.
Side door rehung.
(Any one or more of above items, or similar thereto, constitute running repairs.)

Light Repairs

One or more pair wheels renewed.
Draft timbers tightened and new bolts.
Side door rehung.
Couplers renewed.
Body tightened.
Deadwoods repaired or renewed.
Brake beams repaired or renewed.
(Any one or more of above items or similar thereto constitute light repairs.)

It is my opinion that such a classification will be more satisfactory than to have heavy, medium, light and running repairs subdivided on a money or hourly basis. The objection to the hourly or money basis of subdivision of repairs is that no record is kept of the cost of either labor or material on individual cars. To keep these records would entail a great addition to overhead expense. The proposed plan can be used without any addition to the present clerical force.

In conclusion, the question of freight car repairs may be summarized as follows: Freight equipment should be maintained in approximately 75 per cent condition in order to handle freight without danger of loss or damage due to the condition of the freight equipment; this percentage condition cannot be maintained without the co-operation of all roads, because the freight car today is common property so far as service is concerned.

Discussion

H. H. Harvey (C. B. & Q.): The statement is made in Mr. Shipman's paper that 72.6 per cent of all freight cars should be kept in first-class condition. I question whether it is necessary to have that figure quite so high. It would vary greatly on roads in different localities and will even vary on the different divisions of a single large road. There are many commodities that should never be loaded in a first-class car. One of the worst abuses prevalent on our railroads today is loading hides, fertilizer, immigrant outfits and similar material in first-class equipment. Car men in general are dilatory about calling attention to the abuse of cars. Since cars have been loaded up to the capacity of the axles there has been a great deal of overloading of light cars, and I think the sooner we get back to the 10 per cent overload, the better it will be for the equipment.

J. H. Milton (C. R. I. & P.): The only way that a car can be kept in service with the heavy tonnage handled at the present time is by reinforcing it. When we can get a system in force throughout the United States that will make all the roads reinforce their cars we will get good equipment. Until that is done we will simply repair the cars from time to time and get nothing from our labor. The majority of railroads are spending $50 to $75 to repair cars which only move off the repair track to become bad order again within a week or two. By spending $400 or $500 on these cars they could be put in first-class condition. The equipment is getting worse every day, particularly on the Eastern lines.

F. P. Schultz (Chicago Car Interchange Bureau): The designs of cars are so varied that it is practically impossible to keep a stock of the proper material for reinforcing these cars away from the home road. The Railroad Administration is now moving cars in bad order to the owning roads, and when they get home it is to be hoped that some rules will be formulated that will keep the car on the home road if it is not up to a certain standard. As far as the box car is concerned, I think as long as it is of a design that is kept in general service, it should be maintained in 100 per cent condition. A rough freight car may be given a load that it will carry, but when it is unloaded it may be in a district where there is nothing but grain loaded and the rough freight car will bring back the load of grain which it is not fit to handle. The proper way to handle the rough freight car is to mark it bad order if it is sent out under load.

W. G. Wallace (American Steel Foundries): We have heard a great deal about what has been accomplished by the united efforts of the men in the different regions in handling traffic. Would it not be a good idea to have the transportation men keep more closely in touch with the mechanical men and to prevent car repairs, instead of having so many cars bad ordered? There are a good many things that could be done by getting the transportation officers more interested in the mechanical department problems.

Mr. Milton: I believe the type of underframe required under cars depends largely on the type of draft gear. If a friction draft gear is used the entire shock is thrown on the draft sills. After a spring gear has traveled 1¾ in. the coupler strikes the dead wood and the shock is distributed on all the sills. This takes the load off the draft sills to a certain extent, and for that reason I think it is useless to have a heavy underframe under cars with spring gear.

G. S. Goodwin (C. R. I. & P.): I agree entirely with what Mr. Milton has said. Incidentally, it might be of interest to note that mechanical department circular No. 8 provides that draft sills must be constructed to accommodate friction draft gear, and also that the coupler shall be applied with 3 in. clearance between the coupler horn and the deadwood. The circular permits the application of two classs G draft springs which have a travel of about 1⅞ in. That means that the spring gear must take all the shock, since the horn of the coupler is 1⅛ in. away from the dead wood. It is easy to see what will happen under those conditions.

E. H. Hall (C. G. W.): I do not see how there can be much improvement in the condition of equipment as long as the present rules are enforced. Order No. 12 states that Interstate Commerce Commission Accounting rules must be observed. These rules provide that when the cost of repairs exceeds the major portion of the cost of the car to the carrier, the equipment must be retired. With the present high cost of labor and material the cost of repairs often exceeds 50 per cent of the book value, particularly when equipment has been acquired second hand or through receivership. To get such cars back into service requires additions and betterments which are chargeable to the corporation. It seems that the only thing to do in such cases is to put the cars on a side track until the Railroad Administration or the corporation can agree on the distribution of cost.

F. C. Kroff (Pennsylvania Lines): We have filed the inspection report on a considerable number of cars and have them set aside awaiting disposition. Up to the present time we have received no instructions from the Railroad Administration regarding this equipment.

C. J. Juneau (C. M. & St. P.): We are holding about 200 cars between Minneapolis and Milwaukee awaiting disposition and many more are coming in.

Reinforced Concrete Gondola Car

New Aggregate Used; Design Incorporates Steel Center Sills with Reinforced Concrete Body

An innovation in railway equipment is a reinforced concrete car of the gondola type, invented and designed by Joseph B. Strauss, C.E., president of the Strauss Bascule Bridge Company and recently built by the R. F. Conway Company, Chicago. The plans for the car were drawn up several years ago and patents were secured covering the important features of the design. The actual construction was started during the war when it was thought that it might be possible to relieve the car shortage materially by developing concrete construction.

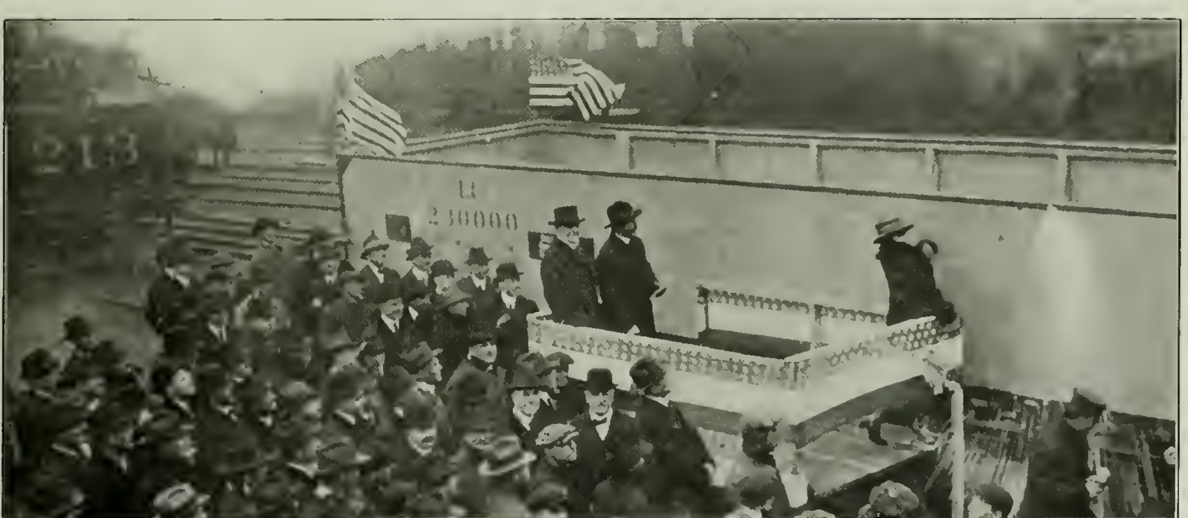
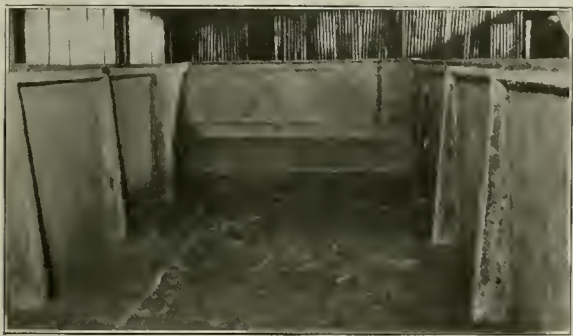


Photo. by International Film Service.

The Christening of the World's First Concrete Freight Car

The fundamental feature of the design is a steel skeleton body mounted upon the standard center sills and bolsters of the U. S. R. A. 40-ft., 50-ton gondola car. Concrete walls and floors are contained within the skeleton steel frame and together with the reinforcement in the floor are connected to the underframe in such a manner that the buffing and pulling stresses are distributed throughout the car body. The car was designed for a capacity of 100,000 lb. plus the usual 10 per cent overload. The end load was assumed at 200,000 lb. with an allowance of 25 per cent for impact, equivalent to an end load of 250,000 lb. The unit stresses in the steel were limited to 16,000 lb. per sq. in., and in the concrete to 1,000 lb. per sq. in. The gondola type was chosen for this experimental concrete car because equipment of this type is subjected to the severest handling. Dumping devices were omitted merely to simplify the construction, but this feature can be incorporated in such cars without any difficulty.

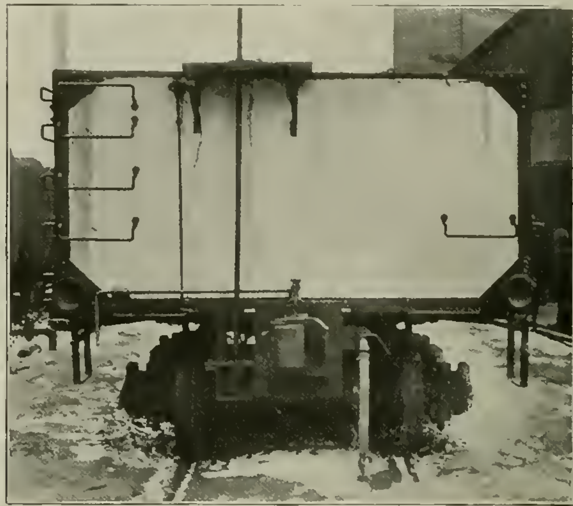
The car has an over-all length of 41 ft. 6½ in., and over-all width of 10 ft. 2⅞ in., with sides 4 ft. 10½ in. high. The steel members of the underframe consist only of the center sill, which is of two 12-in. 35-lb. ship channels, with a 1/4-in. by 20 1/2-in. cover plate, and the body bolsters and diagonal corner braces, which conform to the U. S. R. A. standard design. There are six reinforced concrete cross bearers in the car spaced approximately 4 ft. 6 1/2 in. apart. The size of the section varies from 4 in. by 12 in. at the sides to 4 in. by 1 ft. 4 1/8 in. at the center sill. The floor is 2 1/8 in. thick, reinforced with longitudinal and transverse



Interior of the Car Body

rods 1/4 in. in diameter. Along the outer edge of the floor is a 3 1/2-in. by 3 1/2-in. angle and at the top of the sides there is a 4-in. channel. This steel frame serves as the tension members of the truss and also furnishes a means of attachment for the reinforcing, the side reinforcing rods extending through holes drilled in the angles and channels. The sides are 1 3/4 in. thick and are strengthened at the bolsters and at the cross bearers by reinforced concrete posts.

weight of 104 lb. per cu. ft., and a compressive strength of 4,450 lb. per sq. in. in 28-day tests. It is the result of a manufacturing process developed by Stephen J. Hayde, of Kansas City, Mo. The concrete sections in this car are



Brake Staff End of the Reinforced Concrete Car

thinner than have ever before been attempted in similar work and for that reason it was decided to use the cement gun for the walls and floors. The cross bearers, however, were poured in the usual manner. The forms were placed

Skeleton Steel Frame and Reinforcing in Position in the Forms

Across the end of the car there is a reinforcing rib 6 in. by 1 1/4 in. located 1 ft. 11 3/4 in. from the floor. A diagonal rib extends up to the end from the lower end of the body bolster.

The concrete work on this car represents the first commercial application of a new light weight aggregate known as Haydite. This material produces a concrete having a

on the outside of the car and the skeleton frame and reinforcing were put in position as shown in the illustration. The concrete was then shot on from the interior. The resulting concrete was exceedingly dense and the finish remarkably smooth on the surface which was against the form. The interior was left practically as produced by the gun.

The use of the cement gun increased the specific gravity of the concrete above that computed. This fact, together with the necessity for using heavier steel sections than required in some cases brought the total weight of the car up to 53,600 lb., or 3,600 lb. more than the computed weight. It is evident, however, that with proper facilities for construction another car of this size and design can be made to weigh between 46,000 and 48,000 lb. The conditions under which the first car was built did not permit of certain refinement of design and details of construction, but the plans as now developed for commercial production of such cars have been so advanced that future cars will represent a reduction in weight, simplification of manufacture and lower cost.

This car was built with the sanction and co-operation of the United States Railroad Administration, and it was inspected during construction by J. J. Tatum, supervisor of car repairs. It was turned over to the Illinois Central Railroad on March 17, to be used on that line 30 days, after which it will be delivered to the United States Railroad Administration for such service as it may be desired to place it in. Meantime the further development of the concrete car will be handled by the Concrete Car Company of America, Chicago, which has plans completed for manufacturing concrete cars on a commercial scale.

One of the photographs was taken during the christening ceremonies with which the car was launched upon its career of railroad service, a consideration probably not accorded to any of the other more than two million existing freight cars.

The Automatic Straight Air Brake

I. C. C. Reports Successful Operation in Extensive Tests With and Without Other Types of Brakes

The Interstate Commerce Commission on March 4 submitted to Congress the report of a series of tests conducted by the Bureau of Safety of the air brake system of the Automatic Straight Air Brake Company of New York, as a result of which the bureau submitted the following conclusion: "In the tests of the automatic straight air brake system, both Westinghouse and automatic straight air locomotive apparatus was used with trains made up of various arrangements of Westinghouse and automatic straight air triple valve equipment, and the tests were made under varied operating conditions. Synchronous operation of the automatic straight air brake system with brake apparatus now in common use was secured in all of these tests. On trains equipped entirely with automatic straight air triple valves the reliability and flexibility of the automatic straight air brake system were sufficiently demonstrated." This conclusion, together with a report submitted to Congress June 29, 1916, is the result of a study and test of this system during a period of several years, beginning in 1910, when the triple valve was presented to the Block Signal and Train Control Board, and including experimental tests on the Atchison, Topeka & Santa Fe in 1915 and extensive rack tests and service tests on the Virginian Railway during the period from March to July, 1918.

The apparatus recently tested is a development of that formerly controlled by the California Valve & Air Brake Company of Los Angeles, Cal., tests of which were made by the bureau in November, 1915, which were the subject of the report to Congress in 1916. The tests which are the subject of the new report were made first with the apparatus installed on a 100-car test rack in New York City and later on the Virginian Railway with the same brake apparatus installed on cars used in coal service between the mines in West Virginia and the docks at Sewalls Point, Va.

As presented to the commission for test, the apparatus comprises a triple valve, a high volume feed valve and a compensating valve. The triple valve tested is of the 3-unit type,* the three units being a service section, an emergency section and a change-over section; the equipment also includes a quick action reservoir and a service reservoir in addition to the present auxiliary reservoir and brake cylinder.

This apparatus is designed to produce essentially the following operating results:

(1) Rapid serial action in service applications and in quick release.

(2) The maintenance of uniform and constant brake cylinder pressure, irrespective of piston travel or cylinder leakage. The cylinder is fed from the brake pipe, the pressure in which in turn is maintained by the compensating valve while the brake valve is in lap position.

(3) Graduated release, permitting a variation of brake cylinder pressure at the will of the engineman.

(4) Quick release when desired.

(5) Emergency applications of the brake available at any time during or after any service application, and an automatic emergency application on depletion of train pipe pressure to approximtely five pounds.

As is suggested by the name, the design of this system combines features of the automatic air brake and the straight air brake. Apart from its use to obtain quick release of brakes, auxiliary reservoir air is used only in emergency application. In service application brake cylinder air is obtained from the brake pipe and service reservoir, the auxiliary reservoir serving as a constant pressure chamber to regulate and govern brake cylinder pressure in proportion to brake pipe reduction. The design of the triple valve is such that in a service application the build-up of brake cylinder pressure as compared with the reduction of brake pipe pressure is in the ratio of two to one.

The high volume feed valve and the compensating valve of this system form a part of the brake equipment installed on the locomotive. The high volume feed valve performs the functions and takes the place of the feed valve commonly used, the purpose of this valve being to remove any restriction between brake valve and brake pipe when brake pipe pressure is below the pressure for which the feed valve is adjusted. The compensating valve is designed to compensate for brake pipe leakage during service application, as well as for depletion of brake pipe pressure by action of the triple valves in automatically compensating for brake cylinder leakage; its function is to maintain brake pipe pressure equal to the equalizing reservoir or chamber *D* pressure. It will also perform the equalizing discharge valve functions.

Tests on Virginian

The report includes a description and analysis of standing and running tests on the Virginian Railway from June 4 to July 9, 1918.* In the first tests, series A, the entire 100 cars were used and tests were made before the brake equipment was changed in any respect. When the A. S. A. equip-

*For a detail description of this equipment see the *Railway Mechanical Engineer* for November, 1917, page 633.

*For a description of the test equipment and an account of the final test runs from Princeton to Sewalls Point, see the *Railway Mechanical Engineer* for August, 1918, page 453.

ment had been installed on 10 cars, standing and running tests were made, series B, with a train of 50 cars, 40 equipped with the original Westinghouse equipment and 10 with A S. A. equipment in blocks of four Westinghouse and one A. S. A. In series C, standing tests only were made with 90 cars, 81 equipped with Westinghouse triple valves and 9 with A. S. A. equipment, in blocks of nine Westinghouse and one A. S. A. In series D, E and F a 50-car train was used, 25 cars having each type of triple valve equipment. In series D the cars were arranged in blocks of five Westinghouse and five A. S. A.; in series E and F, the cars of each kind were grouped together, in one case with the A. S. A. ahead and in the other with the Westinghouse ahead. For the standing tests, series G, a 100-car train was used, 81 cars equipped with A. S. A apparatus and 19 with Westinghouse, with the latter on every tenth car and on cars 20 to 30 inclusive. In series H all cars were equipped with A. S. A. triples, and standing tests were made with two trains consisting of 50 and 100 cars, respectively, and running tests were made with a 50-car train. In series I, 100 cars were equipped with A. S. A. apparatus; standing tests were made and the train was run from Princeton to Roanoke. At Roanoke the A. S. A. triples were removed from 50 cars and replaced by the original Westinghouse K-2 triples for the series K tests, which consisted of a test trip from Roanoke to Victoria with the first 49 cars and the rear car equipped with A. S. A. apparatus. Series L consisted of a trip from Victoria to Sewalls Point with the Westinghouse cars ahead. In all, the schedule included about 70 tests, standing, terminal and running.

In series A, brake cylinder leakage tests and retaining valve tests were made for the purpose of securing a record of the condition of the brake equipment. The purpose of the tests in series B, C, D, E, F and G was to demonstrate the operation of both types of triple valves in trains of mixed brakes with and without the A. S. A. engine equipment.

The purpose of the test run from Princeton to Roanoke was to demonstrate the ability of the A. S. A. brake equipment to control a long train on heavy grades, as well as the flexibility of the system for controlling a train on undulating and level grades.

Leaving Princeton, the A. S. A. locomotive apparatus was in service, and on all cars the brakes were operated in graduated release. In making the first brake application after starting down the grade, three brake pipe reductions were made, the total reduction being from 87 to 70 pounds, as indicated by gages on the locomotive; as a result brake cylinder pressures of 36, 29, 35 and 38 pounds were developed on the 1st, 29th, 60th and 95th cars. Following these reductions, the brake valve was not moved to release position in time to restore brake pipe pressure quickly enough and the train stopped before the brakes were released. As soon as pressure was restored the train was again started and a speed of 10 or 11 miles per hour had been attained when an emergency application occurred, due to an air hose being blown off from the 94th car. The train did not part, and was stopped without shock on either end. When the hose had been replaced and pressure restored, the train was started and a reduction of brake pipe pressure from 86 to 70 pounds was made for the purpose of controlling speed. Following this application, as the brakes were being graduated off when speed had been considerably reduced, the train parted, due to the coupler on the 85th car slipping over the top of the coupler on the 84th car, the carrier iron having fallen. This caused an emergency application, and although the speed was very low both portions of the train stopped without shock. Repairs were made and the train proceeded to Kelleysville without stop; the brakes were applied and graduated off and on as required to control the speed, which varied from 16 to 22 miles per hour. No difficulty was experienced in controlling the rate of speed, and the operation of the train was notably free from shock.

At Kelleysville the brakes on all cars were placed in quick release and the train was operated with brakes in that condition from Kelleysville to Whitethorne. Approaching the New River bridge as the brakes were being released following an application, the train parted between the 66th and 67th cars on account of a broken knuckle. The emergency brake application brought both portions of the train to a stop without damage or shock. Again, approaching Rich Creek the train parted between the 89th and 90th cars, due to a broken knuckle, while the brakes were being released, and the brakes on the head end back to about the 60th car had been released. Brake pipe pressure having been restored at the head end, higher brake cylinder pressure on the cars at the head end was built up in the emergency application than on the cars farther back. Notwithstanding this emergency application originated near the rear end, serial action of the brakes from that point to the head end was so rapid that the higher brake cylinder pressure developed on the head end stopped that end of the train first, causing a rather severe run-in of slack. However, the shock was not severe enough to cause any damage and when the coupler had been repaired the train proceeded.

At Whitethorne the brakes of all cars were again placed in graduated release. After passing Merrimac the first two applications of the brakes which were made on the grade east of that point were heavy, and each time the train was stopped before the brakes were released. Subsequently lighter brake applications were made and the speed of the train was controlled properly.

At Roanoke the A. S. A. triple valves were removed from 50 cars and the Westinghouse triples were replaced. On the trip from Roanoke to Victoria the train was made up with the first 49 test cars and the rear test car equipped with A. S. A. apparatus and cars 50 to 99, inclusive, were equipped with Westinghouse triple valves; from Victoria to Sewalls Point the first 50 test cars were equipped with Westinghouse triples and the last 50 with A. S. A. The purpose of these arrangements was primarily to determine what, if any, slack action there would be between cars with different types of brake apparatus grouped together in large numbers in different parts of the train and whether proper synchronous and serial action would be obtained under varied braking conditions encountered.

The trip from Roanoke to Victoria was made on July 8. Leaving Roanoke the brakes on 49 A. S. A. cars were operated in graduated release. On the grade between Goodview and Huddleston very light brake pipe reductions were made for the purpose of controlling speed, the reductions varying from two to four pounds each. At Stone Mountain approximately half-way down the grade, the train was brought to a stop to meet an opposing train. From that point it proceeded to the bottom of the grade without a stop, the operation being remarkably smooth and free from shock.

At Taber, 54 miles east of Roanoke, the brakes on the A. S. A. cars, except the first 25, were placed in quick release and the trip from Taber to Victoria was completed with the brake apparatus in that condition. Near mile post 129, about 9 miles west of Victoria, while running at a speed of about 20 miles per hour, the train parted between the 99th and 100th test car, due to a short knuckle pin and the top coupler lug being broken off. Before the break-in-two the brakes were not applied. The emergency brake application brought it to a stop without damage or shock.

The run from Victoria to Sewalls Point was made on July 9. A box car loaded with equipment and tools was hauled next to the locomotive, and there were four cabooses on the rear end; the brakes on the cabooses were not used. Approaching Purdy, approximately 40 miles east of Victoria, there is an ascending grade eastbound of .2 per cent followed by a descending grade of .21 per cent for a short distance and then by a descending grade of .5 per cent. Approaching Purdy an application of the brakes was made and before the rear end had reached the crest of the ascending grade, the head end being on the descending grade, the brake valve was placed in full release position for a period of nine seconds and then returned to running position. The train parted between the 82nd and 83rd cars, the knuckle on the rear end of the 82nd car being broken. Trainagraph charts indicated that prior to the break-in-two the brakes had been released back to about the 50th car, and it is apparent that the contour of the line, together with the short release period and a bad flaw in the knuckle caused the break-in-two. After the knuckle had been repaired the trip to Sewalls Point was completed without noteworthy incident.

DISCUSSION

In the discussion of the tests, the report says the A. S. A. brake equipment is considered, first, as used in mixed trains with other types of brake apparatus now in common use, and, second, when A. S. A. brake equipment exclusively was used in the test trains. In mixed trains, in both standing and running tests, synchronous operation with the Westinghouse apparatus was obtained, and the control of mixed trains having a large percentage of A. S. A. triple valve equipment under varied braking conditions, including heavy, undulating and level grades, was, with but one or two exceptions, notably free from shock.

The design and construction of the A. S. A. triple valves used in the Virginian tests provided for low brake cylinder pressure for a given brake pipe reduction, as compared with the Westinghouse triple valves, particularly in view of the short piston travel maintained on the Virginian Railway. In mixed trains better braking conditions would be provided and more harmonious operation with other types of brake apparatus if the A. S. A. brake provided higher brake cylinder pressure in proportion to brake pipe reduction. It is noted that this is merely a detail of construction and an increase in the present ratio can easily be obtained.

In mixed trains with the A. S. A. triple valve equipment on the head end the functions of graduated release were accomplished and tests demonstrated that the graduated release feature of the A. S. A. triple when used on the head end of mixed trains is very desirable under operating conditions similar to those encountered on the Virginian Railway, also emergency operation of the A. S. A. cars on the head end of mixed trains was obtained following a service application when the initial reduction was not too great. The use of A. S. A. triple valves in mixed trains on account of locally reducing and increasing brake pipe pressure results in some degree in more positive operation and an improvement in serial action both in applications and in releasing the brakes, the degree being dependent upon the number and location of the A. S. A. triple valves in the train.

On cars equipped with A. S. A. apparatus, the A. S. A. triple valves supplied comparatively uniform brake cylinder pressure which was not affected by piston travel, brake cylinder leakage or pressure retained in the brake cylinder at the beginning of an application; but under present practices of controlling trains the brakes ordinarily are not held applied long enough to obtain the full advantage in mixed trains of compensating for brake cylinder leakage.

In the standing tests with trains having all cars equipped with A. S. A. triple valves, practically all the intended functions were accomplished. In general, proper serial action in both application and release was obtained; when operating in graduated release the brakes were graduated on and off as desired, being fully released as intended when normal brake pipe pressure was restored. Comparatively uniform brake cylinder pressure was obtained regardless of piston travel or of pressure retained in the brake cylinders by the retaining valves, and it was maintained notwithstanding ordinary brake cylinder leakage. Emergency operation following a service application was not secured in every case when desired; after the installation of the special emergency valve on the locomotive, emergency operation was secured when the initial service reduction was 20 pounds or less. The emergency tests demonstrated that after a full service reduction followed by a full release period as short as 10 seconds emergency operation of the triples throughout the train can be secured. The automatic emergency feature of the triple valves tested, which becomes effective when the brake pipe pressure had been depleted to five pounds or less, was so much delayed as to be of little or no practical value; to make this feature of the brake system useful the period of time required before the automatic emergency operation occurs must be materially decreased, which can be accomplished by making this function operative at a higher brake pipe pressure. In the test providing for an angle cock on the rear end of the train to be opened with the brake valve in running position, the emergency operation carried to the head end of the 100-car train.

In the running tests on the grade between Princeton and Kelleysville with 50 and 100-car trains equipped exclusively with A. S. A. triple valves the operation of the brakes was precise and uniform and the control of the slack action during application and release of the brakes was practically ideal. The speed restriction for freight trains on this grade is 12 miles per hour, but was not observed in common practice. The test trains were in several cases permitted to attain speeds more than double the maximum authorized before the brakes were applied, necessitating a heavy brake application to control them. The pressure developed in the brake cylinder was comparatively uniform except on the head end, where high brake cylinder pressure resulted from an overcharge of the brake pipe while the brake valve was in full release position. The release of the brakes even at as low speed as two miles per hour resulted in no bad effects from slack action, but was very uniform.

In the two cases when the train parted between Kelleysville and Rich Creek the brakes had been released on the forward portion of the train and the break-in-twos occurred between cars farther back in the train on which the brakes were still applied. In neither case was there any noticeable shock or slack action at either end of the train prior to the break-in-two. At the time of these break-in-twos all of the triple valves were operated in quick release and no retaining valves were used. None of the emergency operations on the 100-car train on the trip from Princeton to Roanoke, originating at different points in the train, caused excessive shock and no damage to train or equipment resulted, notwithstanding the low rate of speed in the first two instances. After turning the summit of the grade at Merrimac, all cars being in graduated release, an excessive brake pipe reduction was made; in attempting to release the brakes the brake valve was held in full release position long enough to fully release the brakes on the head end, but the train was stopped before release on the rear end was secured. This resulted in slack running out, and a comparatively severe shock on the rear end, but this shock was not severe enough to cause any damage. When the break-in-two occurred at Purdy the brakes had been released on the first half of the train only and the rise in brake pipe pressure had barely reached the first A. S. A. car when the train parted; this break-in-two was also clearly due to improper manipulation of the brake valve rather than to any arrangement or feature of the triple valve equipment.

The A. S. A. feed valve and the compensating valve included in the A. S. A. locomotive equipment operated as designed and intended. The tests demonstrated that it was not necessary to use any special locomotive brake equipment in order to secure proper action of the A. S. A. triple valve, but the maintaining and compensating functions of the A. S. A. triple valves can be more fully accomplished and utilized when the compensating valve on the locomotive is used. Some alteration in the detail arrangement of the compensating valve on the locomotive as used in these tests is necessary in order not to interfere with emergency operation following a service application. When the compensating valve is in service in case of the train parting or a break in train line the brake valve must be placed in emergency position to prevent depletion of the main reservoir pressure.

In the tests of the A. S. A. brake system particular attention was devoted to principles of design and the functions accomplished. Some improvements, particularly in regard to the feature of securing emergency operation following a service application, can be effected and the construction of the A. S. A. triple valve can be materially simplified. An application of the principle of automatic straight air brake valves to meet the conditions of passenger train breaking was not considered in connection with these tests, which were entirely with freight equipment.

Treated Lumber for Freight Cars*

Possibility of Prolonging the Life of the Wooden Parts of Car Construction; Methods of Treating Used

Over two billion feet of lumber and timber are used annually for the maintenance of railway freight equipment and for the construction of new cars. This represents an annual outlay for material alone of approximately $60,000,000. To this must be added, of course, an even greater expenditure for labor, steel and other material. With a view of ascertaining the service which untreated wood has given in this character of construction and with the desire also to learn to what extent it has given added service in specific cases through wood preservation, and to what extent economy would be developed by the general adoption of the practice of wood preservation, and further, as the subject is of very pertinent interest at this time, the committee felt it advisable to make this study a subject of special investigation, both through the medium of a questionnaire to all car builders and by means of personal study.

The preliminary investigation developed that there was very little information available on this subject. As it was felt that it was a matter of great importance, and that it should be gone into thoroughly and fully, a questionnaire was prepared and sent to the members of the Master Car Builders' Association.

The questionnaire covered the following information, which, it was felt by the committee and collaborators, was necessary to a thorough fundamental study of the subject:

For Car Construction—(a) Availability, cost and quality of lumber and timber. (b) Suitability and economy of wood. (c) Factors affecting the physical and mechanical fitness of wood. (d) Importance of the assistance it may be possible to render the nation and railroads by augmenting the car building program by the extensive use of wood.

Eighty-eight questionnaires were returned representing about 75 per cent of the most important railroad systems of the country. Of these, 61 were analyzed and the replies summarized in tables published in the appendix, 21 were discarded for lack of information, and six were too late to be included in this report.

Table 1—Summary of Replies to Question No. 1

Percentage of Maintenance Due to Decay Grouped According to Expressions of Respondents (Number of Replies Given)

Type of cars	75 per cent and over	50 to 75 per cent	25 to 50 per cent	Less than 25 per cent	Indicating considerable loss due to decay	Refuting influence of decay	No reply	Total Questionnaires tab.
Ref. ...	11	7	8	3	18	5	9	61
Stock ...	4	11	9	9	14	2	12	61
Gond. ...	2	9	12	12	13	3	10	61
Flat.	1	14	7	17	8	4	10	61
Box	0	7	7	25	9	3	10	61

Note—Approximately 77½ per cent of those replying indicate that decay is decidedly an important contributing factor.

RESULTS OF INVESTIGATION

Question 1. To what extent, in general, does decay influence maintenance of all-wood and composite freight cars? (i. e., general observations from practical experience desired.) (a) Refrigerator cars? (b) Stock cars? (c) Gondolas? (d) Flat cars? (e) Box cars?

Over 75 per cent of the replies indicate that decay influences the maintenance of wooden freight equipment to a considerable extent, and only 9 per cent have given it as their opinion that decay is not a contributing factor. The indications are that conditions favorable to decay vary with the type of car, it being most predominant in refrigerator and stock cars, less in gondola and flat cars, and least in box cars.

Table 2.—Summary of Replies to Question No. 2 (a)

a—Underframe—Parts repaired or replaced due to decay previous to the expiration of the mechanical life. Number of replies referring to each part are given.

Points of contact are chiefly referred to, i. e., mortises, tenons and enclosed areas

Type of cars	Sills in general	End sills	Side sills	Intermediate sills	Center sills	Floors or decking	Nailing strips, composition cars	Draft timbers or sills	Body bolsters	Hoppers	Cross ties
All types. ..	24	10	9	4	5	11	1	3	2	..	1
Refrigerator.	13	3	9	1	..	11	..	2	3	..	..
Stock	8	4	8	1	..	12	..	..	..	..	..
Gondola ...	9	4	4	3	1	10	..	..	..	1	..
Flat	9	2	3	2	..	9	1	..	..	..	..
Box	2	3	10	..	..	..	..	..	..	..	..

Note—Sixty questionnaires analyzed. Two gave no reply to Q. 2-A.

Question 2. What portions of these various types of cars are most affected by decay? (i. e., where is decay the direct cause for replacements and repairs, or indirectly the cause of mechanical failure due to the weakening of certain parts resulting from attack by decay? (a) Underframe (name parts)? (b) Superstructure (name parts)?

(a) Over 95 per cent of the replies specify sills and about 90 per cent state that floors or decking of refrigerator, stock and open cars are replaced because of decay. The predominating opinion is that the points of contact are chiefly affected and weakened to such an extent as to cause mechanical failure of the entire parts. (b) Posts and braces, roof boards and siding at the points of contact, appear to be most affected. Other parts mentioned which are subject to failure due to decay are: Running boards, saddles, side and end plates, ridge poles and purlines.

Question 3. What species of wood do you employ for the following parts of refrigerator, stock, flat, gondola and box cars? (a) Draft timbers? (b) End sills? (c) Side sills? (d) Intermediate sills? (e) Flooring? (f) Posts? (g) Siding? (h) Lining? (i) Ridge poles? (j) Purlines? (k) Carlines? (l) Side and end plates? (m) Roof deck?

The prevailing practice is to require oak for draft timbers, end sills, posts and braces. Douglas fir and Southern yellow pine are generally used for all other purposes. The pine predominates owing to the nearness of the plants to the source of supply. In new construction, steel is very largely used in center sills, and to some extent for side sills and for draft rigging.

*From a report presented at the convention of the American Wood Preservers' Association held in St. Louis on January 28 and 29.

Question 4. What service records have you which are available for the study of this subject? (a) Natural life of untreated car material (name parts).

Ninety-three per cent of the answers stated "No record." The remainder reported as follows: Sills, five to eight years; roofs, four to six years; flooring (stock cars), four to six years; posts and braces, six to eight years.

TABLE 3. SUMMARY OF REPLIES TO QUESTION 2 (b)

b—Superstructure—Parts repaired or replaced due to decay. Number of replies mentioning each part given.

	Posts and braces	Roofs, decks or roof boards	Ridge pole and roof nailers	Hatches and ice boxes	Running boards and saddles	Side-plates	Siding	Sheathing inside and end	Stakes	Purlines	Top plates
All types...	31	14	4	..	5	7	9	2	..	1	3
Refrigerator.	8	7	..	6	..	2	1	3	..	..	1
Gondola ...	..	..	..	..	..	..	5	..	2	..	..
Stock	9	4	..	..	..	2	1	..	..	..	..
Flat	..	..	..	..	..	..	..	..	..	..	..
Box	8	9	..	..	..	..	2	1	..	..	1

Note—Sixty questionnaires analyzed. Three gave no reply.

Question 5. Have you used treated timber in car construction? If so, state kind and character, species and treatment.

Eighty-five per cent answer "No." Fifteen per cent reply "Yes," representing 10 railroads which have used coal tar preservatives, creosote oil, paint and other proprietary products.

Question 6. What has been the experience with treated car material, if any? Please state this in detail, by reference to part and character of service.

Eighty-five per cent of the answers stated "No experience." The balance report varying experience referred to in later questions.

Question 6-A. Does the handling of creosoted material in the shops present any labor problems?

Replies from the few firms having experience indicate that labor objects to handling freshly creosoted timber. (The committee feels that this is not a serious objection as it can be overcome by proper practices.)

Question 7. What service records can you give of treated car material?

Ninety-five per cent of the replies give no information, but 5 per cent of the replies give the following records: Reply No. 48. Treated refrigerator car sills in service from three to seven years. Reply No. 30. Treated log car sills in service eight years. Reply No. 26. Treated stock car sills and flooring in service six years. All of the above treated material is still in good condition.

Question 8. If creosoted sills are employed for refrigerator, box, stock and gondola cars, can all stenciling be applied to the body of the car?

Fifty per cent of the replies state "Yes" and 15 per cent state "No." The remainder do not reply.

Question 9. If creosoted sills are employed for flat cars, would it be practical and economical to use metal numerals and signs to replace stenciling?

Over 60 per cent state it is practical. Opinion is evenly divided as to whether it is economical.

Question 10. If stock cars are built of creosoted lumber throughout, would it be practical and economical to use sign boards on both sides for all stenciling?

Over 95 per cent agree that it is both practical and economical.

Question 11. Would it be satisfactory practice to use creosoted sills, sub-flooring and roofing for refrigerator cars? If not, why?

Opinion appears to be evenly divided as to whether creosoted material may be expected to contaminate lading, but one firm with several years' experience states that such practice is satisfactory.

Question 12. What is the mechanical life of the various types of cars, as follows: (1) Wood? (2) Composite (steel underframe)? (3) Composite (steel center sills only)? (a) Box? (b) Refrigerator? (c) Stock? (d) Flat? (e) Gondola?

It is evident from the character of replies to this question that the respondents had in mind the mechanical life of the car as meaning the full period of its usefulness, from the time of construction to the time the car is "wrecked" or dismantled, as being unprofitable, disregarding the outlay of repairs expended on it or the extent to which reconstruction was necessary at any time. In this case the committee feels a more reasonable definition of "mechanical life" would be the period required in which the expenditure for repairs, with interest, equaled the original cost of the car.

Question 13. Would the use of creosoted timber in underframe and superstructure materially increase the period of mechanical usefulness of all types of cars, or any particular type?

Eighty per cent of replies say "Yes," and 20 per cent say "No."

Question 14. To what extent would the use of creosoted sills, flooring, posts, roofing, etc., reduce repairs?

Over 80 per cent of the replies indicate that treatment would reduce repairs. The percentage of saving varies from less than 25 per cent to more than 50 per cent.

Question 15. Have you had experience with the brush treatment of sills (mortises, tenons, end, etc.) with coal tar or creosote?

About 65 per cent report having experience with brush treatment. Ten different products were used.

Question 16. Have you had experience with treating car material by the open tank system (hot and cold treatment) or by dipping (short immersion) using creosote oil? (a) If so, what procedure was followed in the treatment and what preservative was used? (b) What were the results obtained, and what is your opinion of the value of such treatment?

Less than 10 per cent report experience. Only one employs the standard open tank process and states that "Such treatment very greatly increases the life of the materials treated."

TABLE 4—SUMMARY OF REPLIES TO QUESTION NO. 3

Number of references to various species for different parts given

Species of wood used by

Part	White oak	Red oak	Oak general	So. Y. pine	Fir Douglas	Maple	Norway pine	White pine	Hemlock	Fir noble	Hickory	Red gum	Spruce	Cotton wood	Tamarack	Cypress	Mal iron or steel	Total ref's to parts
Draft timber ....A	7	1	47	2	1	2	..	..	..	..	..	1	..	..	..	..	9	70
End sills ....B	8	..	44	8	5	1	..	..	..	..	..	..	..	..	..	..	..	66
Side sills C	..	..	3	46	15	..	..	..	..	..	..	..	..	..	..	..	2	66
Inter sills ....D	..	..	2	46	15	..	..	..	..	..	..	..	..	..	..	..	1	64
Flooring ....E	..	..	5	46	14	2	1	..	..	..	..	..	.	..	2	1	..	71
Posts ....F	5	2	37	19	14	1	..	1	..	1	1	1	1	..	..	..	..	83
Siding ....G	..	..	..	43	16	..	..	2	..	1	..	..	..	..	..	1	..	63
Lining ....H	..	..	..	41	12	..	5	1	3	..	..	..	2	1	1	..	..	66
Ridge poles I	..	..	1	44	14	1	..	1	..	..	..	..	1	..	..	..	..	62
Purlines ....J	..	..	2	44	14	1	..	1	..	..	..	..	1	..	..	..	..	63
Carlines ....K	1	1	26	28	11	3	3	1	..	..	..	..	1	..	..	..	..	75
*S. & E. plates...............L	2	..	29	39	12	2	1	1	..	..	..	..	..	..	1	..	..	87
Roof deck ....M	..	..	..	43	13	..	1	5	1	..	..	..	..	..	..	2	..	65
Total references to species.	23	4	196	449	156	13	11	13	4	2	1	2	6	1	4	4	12	901

*End plates usually specified oak. Side plates, pine or fir.

Question 17. Have you employed car lumber creosoted by standard pressure processes? (a) If so, what species? (b) What specifications for treatment and preservative were followed? (c) What have been the results, and what is your opinion of the value of such treatments? (d) Have you used by any other method of treating for the purpose of retarding decay? (If so, mention material used, with results.)

But one firm reports experience with pressure treatment, having used with satisfactory results, both straight creosote and the Card process.

Question 18. To what extent would your shop practice be affected by the introduction of treating processes, and what method of preservative treatment would be the most practical, efficiency thereof considered?

The majority feel that shop practice would be affected to a greater or less degree by the adoption of wood preservation, indicating that the introduction of preservative treatment would necessitate at least some changes.

MISCELLANEOUS DATA

Question 1. What experience have you had with the use of "new" species of wood in car building? (e. g., have you used Sitka spruce, noble fir, Western white fir, or other species which are not common?)

The replies showed the new species used for various parts of cars were as follows: Roofing—Western hemlock, redwood, cypress, Sitka spruce, noble fir. Siding—cypress, Sitka spruce, noble fir. End sills—gum. Lining—noble fir. Decking—noble fir. Sheathing—Port O cedar. Posts and braces—Sitka spruce.

Question 2. To what extent have you used hardwoods such as oak, maple or birch, for flooring in cars subject to excessive mechanical wear? (a) Do you consider the extra life of hardwood parts justifies the expense?

Oak and maple are generally used in ore cars and to some extent in flat and gondola cars. A few firms report use of birch, hickory and beech for such purposes, and a few use pine or fir in these types of equipment. (a) More than 70 per cent of replies indicate that extra cost of hardwood parts is justified by greater life.

Question 3. What is the average amount of car stock kept on hand at your shops or yards? (a) Is this stock stored in sheds? (b) What is the percentage of loss from warping, weathering and decay? (c) What difficulties do you have in getting car stock true to grade and properly seasoned? With what species have you had this trouble?

Reports indicate that smaller shops carry from 60 to 90 days' stock whereas those which consume over 40,000,000 ft. per year carry a 12 months' supply of soft woods and an even longer supply of hardwoods. The practice of carrying a year's supply in order that the wood may become properly seasoned before use is to be commended very highly. It is essential that wood be thoroughly seasoned where it is to be given preservative treatment. (a) Replies indicate that the general practice is to store dressed lumber, kiln-dried stock and high-grade hardwoods in sheds. (b) Three-quarters of 1 per cent on the average is the loss from warping, weathering and decay. (c) Replies indicate that in recent years increasing difficulty has been experienced in securing satisfactory grades of oak and other hardwoods.

TABLE 14—SUMMARY OF REPLIES TO QUESTION 12

WHAT IS THE MECHANICAL LIFE OF THE VARIOUS TYPES OF CARS?

Sixty-one Questionnaires Analyzed to November 5, 1918

Mechanical Life as Stated by Questionnaire

Box Cars																							
Years life	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	25	26	28	30	35	40	No reply
Wood	..	2	3	1	..	5	..	4	1	..	4	3	..	4	..	13	1	3	..	..	4	..	..	13
Composite, steel underframe	..	..	..	2	..	2	..	..	..	1	2	..	1	2	..	4	..	6	1	..	4	..	1	35
Composite, steel center sill	..	..	1	..	1	1	..	1	..	..	3	..	..	3	..	4	1	4	..	..	..	..	..	42
Refrigerator Cars																								
Years life	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	25	26	28	30	35	40	No reply
Wood	1	4	1	1	..	5	..	1	..	1	7	2	..	2	..	2	..	3	..	..	1	..	..	30
Steel underframe	..	1	1	..	1	..	1	5	1	..	..	..	..	..	1	1	..	1	1	..	5	1	..	41
Steel center sill	..	1	1	1	..	2	..	2	..	1	..	1	..	..	..	2	..	2	..	1	..	..	..	47
Stock Cars																								
Years life	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	25	26	28	30	35	40	No reply
Wood	1	3	1	4	1	4	..	2	1	..	2	2	..	1	2	10	1	3	..	..	..	..	..	23
Steel underframe	..	1	..	..	1	2	..	2	..	..	2	..	..	..	1	4	..	2	1	..	2	2	1	40
Steel center sill	..	1	..	1	..	3	..	1	..	..	2	1	..	1	..	4	..	1	..	..	..	..	..	46
Flat Cars																								
Years life	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	25	26	28	30	35	40	No reply
Wood	1	3	..	4	..	9	..	..	..	3	6	1	2	2	..	7	..	4	..	..	1	..	..	18
Steel underframe	..	1	..	1	1	1	..	1	..	..	8	1	..	2	..	2	..	4	1	..	3	1	..	34
Steel center sill	..	1	..	1	..	1	..	3	..	2	1	..	..	..	1	3	1	1	..	..	..	1	..	45
Gondola Cars																								
Years life	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	25	26	28	30	35	40	No reply
Wood	3	2	..	2	..	9	..	1	..	1	9	1	2	1	..	7	..	2	..	..	2	..	..	19
Steel underframe	..	1	..	2	..	2	..	..	..	2	2	1	..	1	..	4	..	3	1	..	3	1	..	38
Steel center sill	..	1	..	1	..	2	1	1	..	2	1	..	..	2	..	3	..	1	..	..	1	..	..	45

Note—Where the reply stated a term of years, i. e., "from 6 to 8 years," an average of the two figures was used in summary, i. e., 7 years.

Question 4. What efforts are made toward salvage of old car lumber at repair shops?

A general effort is apparent throughout the industry to salvage all material that can be worked over at a profit. The following instances of use for salvaged lumber are given: Old siding and lining cut into roof repairs, grain doors, coal doors, yard and snow fences. Old car sills cut into sill splices, cross-ties, engine wood, shims, car stakes, narrow gage ties, cripple posts, running board saddles, blocking, framing posts. Old roofing cut into yard fencing.

Question 5. What is the comparative life of single sheathed and double sheathed box cars of similar weight and capacity?

Three firms report the double sheathed box car has up to 25 per cent longer life than single sheathed. Four firms report single sheathed up to 50 per cent longer life than double sheathed. Four report that the life of the two classes of car is practically identical. The remainder report no figures available.

TABLE 17—SUMMARY OF REPLIES TO QUESTION 15

Tabulation of replies, number who used some sort of brush treatment—what product and whether satisfactory

Brush treatment used 37 — No treatment used 21 — No statement 3

Number of replies	Products used	Satisfactory	Unsatisfactory
8	Creosote	8	0
2	Coal tar	2	0
1	Carbolineum	1	0
18	Paints	13	5
5	Wood tar preservatives	4	1
2	Proprietary asphalt waterproofing products	2	0
1	Carglue	1	0
37		31	6

The report was signed by H. S. Sacket (C., M. & St. P.), chairman; K. C. Barth (Barrett Manufacturing Company), chairman sub-committee on Car Construction; Lowry Smith (N. P.), F. V. Dunham (Southern Pine Association), W. W. Lawson (T. & N. O.), V. R. Hawthorne, acting secretary Master Car Builders' Association, and S. W. Allen, United States Forest Products Laboratory.

DISCUSSION

J. H. Waterman, superintendent of timber construction, Chicago, Burlington & Quincy, reported that large quantities of timber had been treated and used in the construction of stock cars during the period from 1911 to 1914, inclusive. Recent investigation at all car repair yards on the system indicated that there was no record of any of these cars having been repaired to date, because of the decay of the treated timber. This treated timber was used for floorings and sills; the average life of untreated timber for these purposes is three or four years.

L. K. Sillcox, master car builder, Chicago, Milwaukee & St. Paul, at Milwaukee, urged the treatment of car roofing timbers and the material in stock cars.

J. H. Milton, superintendent of the car department, Rock Island Lines, favored the treating of longitudinal sills, posts and decking for gondola and stock cars, but opposed the creosoting of timber for box and refrigerator cars, because of danger of injury to the lading.

Car Inspection and Maintenance*

Unification Demands Capable Supervision and Inspection and the Backing of Operating Officers

BY J. J. TATUM
General Supervisor of Car Repairs, United States Railroad Administration

IT has generally been found by railroad managements that the inspection and maintenance of car equipment is not uniform and they have frequently urged unification of inspection and repairs, deeming it to be an important factor of safety, good performance and economical operation.

Unification of inspection and repairs to equipment was found by the United States Railroad Administration to be such an important requirement of good railroad performance that it soon began to lay plans and make instructions effective that would unify inspection and repairs, as well as to standardize equipment.

For this reason Circular No. 7 was issued, June 8, 1918, by C. R. Gray, former director of the division of operation, to insure that inspection and repairs would be properly made to car equipment. Mechanical Department Circular No. 7 was issued October 17, covering repairs to refrigerator cars for the purpose of standardizing the repairs to refrigerator cars to such extent that they would be suitable for the service they are intended to perform. Mechanical Department Circular No. 8 was issued November 1, 1918, for the purpose of standardizing materials for freight car repairs in order that repairs could be made promptly and uniformly.

Knowing that certain things must be done and issuing instructions to do them does not always mean they will be done, or that the instructions issued will be complied with. Something more is required. The men in charge should be capable not only of issuing instructions but capable of knowing when instructions are being complied with. They should also be capable of issuing workable instructions and selecting men who are capable of complying with their instructions.

If this statement is true then we should have thorough, capable and efficient men at the head of car departments, who know when a car is properly inspected and how to inspect it. They should know when a car is properly repaired and how to repair it. If they are capable of doing this, they should then be capable of selecting the right men to see that this work is properly performed. They should know that the foremen they have placed in charge of their repair shops are not only capable of repairing cars and knowing that they are properly repaired but that they are also capable of seeing that the men doing the work do it properly.

When selecting a man as foreman car inspector or leading inspector, it should be known that the man selected is not only capable of inspecting a car and knowing when it is properly inspected, but that he is capable of selecting men as inspectors who are able to inspect cars properly.

After these requirements are met, we may look with confidence for unified inspection and maintenance of equipment, but not until then.

Even after this is done there will still continue to be improper inspection and maintenance of equipment and a variance from the unification requirements if those in charge of these men do not respect their action. I mean by this statement that inspectors should be given all trains to inspect and they should be permitted to hold them a sufficient length of time to give each car the needed inspection and repairs, or to shop the defective car out for repairs. After a car inspector has shopped a car for defects which make it unsafe to be continued in service, no one should be permitted to cause such car to be placed back in service until the repairs for which the car was shopped have been made properly, or improper repairs corrected. One giving or assuming such authority, will by his act, become an enemy to safety and a promoter of disaster that may result in loss of life or limb and destruction of property.

It should be considered just as serious and dangerous for one to remove a shop card from a defective car and permit it to go into service without necessary repairs being made, or permit a car to go into service with a shop card on it without the repairs being made, as it would be for one to change a red signal to white before an approaching train, without knowing whether or not the block into which the train is to move is safe and clear. In my opinion, one act is just as serious and just as liable to cause disaster as the other.

Therefore, Mr. Railroad Manager, it is with you to see to it that your car inspectors are given your trains to inspect, with the time to make needed inspection and repairs. If this is not done you should be responsible for the failure of such cars and not the head of the car department or his inspector. It also lies with you to see that the car inspector's action, when shopping a car out for repairs, is given your full support, to the extent that, should anyone remove a shop card from a defective car and permit it to go into service before necessary repairs are made, or place a car in service with a shop card on it, such person should be relieved from the service for the good and safety of all concerned. If this is not done, then the motto we have established—"Safety First"—is only a mockery and you are deceiving yourself as well as the public, in your efforts to promote such a doctrine.

The protection of millions of passengers using the railroads of our country, as well as railroad employees, and the protection of billions of dollars' worth of railroad property and billions of dollars of freight hauled in cars operating over our railroads depends upon the thorough and careful inspection made to our cars. There also depends upon their careful inspection and the repairs to equipment the protection of foodstuffs needed to feed hundreds of millions of people. With this great responsibility upon the inspectors, their value cannot be discounted.

To bring about these desired conditions it is necessary that we first select for the heads of our car departments men who have been thoroughly trained and well experienced. They should see to it that inspectors selected are capable of making safe and proper inspection of car equipment. This can only be established by requiring inspectors to pass an examination that will insure that after once passing the examination they are capable of performing the work assigned to them.

They should also see that inspectors are given all trains to inspect and permitted to hold them until inspection is made. Cars once inspected and passed as being fit for service should be in such condition that, when inspected again at next inspection point, they will not be shopped out for defects that existed at the time of the previous inspection; neither should they fail while in movement due to such defects. In other words, should an inspector pass a car as being safe and fit for loading at St. Louis that car should be in condition to continue through to New York or any destination without being shopped out or breaking down in movement, due to

*Abstract of a paper read before the Central Railway Club at Buffalo, N. Y., March 14, 1919.

defects existing when the car was inspected at St. Louis. When a car repaired on shop tracks at Chicago is moved to New York for loading it should not be necessary to shop it for defects that existed when it was placed on the shop tracks, or for improper repairs made at Chicago, on or before its arrival at New York. No car should be placed for loading until first inspected and given needed repairs.

Unless we are able to obtain these desirable conditions our inspection or our repairs are not uniform, or our supervisors are not capable and efficient, or someone is removing shop cards or causing cars to leave inspection points or repair yards before they are in proper condition for service.

Unless such practices are corrected (if they exist) we cannot expect to establish the unified requirements which would result in safe and economical operation. Unified inspection and repairs will mean to our railroads less loss of life and limb of passengers and trainmen, greater car mileage, fewer accidents, less destruction of equipment and property, less repeated shopping of cars, greater car supply, less need for purchase of new equipment, decrease in cost of operation, less maintenance cost, prompt handling of business, greater satisfaction to shippers, better earnings for railroads and a more satisfactory dividend for the stockholders.

DISCUSSION

In presenting his paper Mr. Tatum referred to the fact that of the more than two and a half million freight cars in the country about 125,000 cars are being held for repairs and more than 100,000 cars are being repaired per day. There are on 80 railroads, or about 57.6 per cent of the railroads reporting to the Railroad Administration, less than four per cent bad order cars. On February 15 there were 141,000 men employed in car repairs on 139 Class I railroads, which were holding an average of slightly over five per cent of their cars in bad order.

F. W. Brazier, superintendent rolling stock, New York Central, questioned the significance of the figures given by Mr. Tatum as to the number of cars actually in bad order condition, owing to the fact that instead of giving cars thorough repairs too many of them had only received sufficient repairs to get them temporarily back into service. He endorsed the requirements for unification outlined by Mr. Tatum, stating that the instructions are clear enough, but that little attention is paid to some of them; when business is rushing there is a great demand for equipment and only such repairs are made as will keep the cars running, instead of giving them the thorough repairs they need, when they are empty and on the repair track. M. C. B. Circular 4-A, now in effect, was quoted to show that it is not so much instructions that are needed as some way of securing their full observance. This circular alone, if carried out, would greatly improve the condition of equipment not now suitable to meet modern service conditions. In this connection Mr. Brazier stated that the New York Central on August 1, 1918, had 7,000 cars yet to be equipped with safety appliances. Since that time only eight cars have been reported as being equipped with the safety appliances on foreign lines, as compared with 370 foreign cars which have had the appliances brought up to standard on the New York Central Lines. The need of adequate force behind instructions, if they are to be carried out, was further emphasized by Mr. Brazier, who cited the case of the safety appliance standards now adopted and enforced by the Interstate Commerce Commission. The Master Car Builders' recommendations for the ladder location were complied with by about 85 per cent of the railroads, but the other 15 per cent of the roads persisted in applying their ladders in exactly the opposite location. The Interstate Commerce Commission did not formulate new standards, but it required the force behind the Safety Appliance Acts to bring about 100 per cent compliance with the standards formulated by the association.

The need of the highest type of supervision in the car department was emphasized, its importance being indicated by the fact that in 1917 the New York Central spent $8,000,000 in the maintenance of locomotives, whereas the car department's expenditures totaled $17,000,000. But labor conditions have been such during the past year that it has been difficult to keep men in the service long enough to develop good inspectors.

Commenting on Mr. Tatum's remarks as to the need of holding trains for thorough inspection, Mr. Brazier advocated that no car be placed for loading until it has passed a thorough inspection. Such inspection should apply particularly to the running gear, brake rigging and draft gear, which must be in first-class condition on all cars, while some other parts of the car need not necessarily be in perfect condition to receive certain classes of lading.

Mr. Brazier called attention to the air brake situation, which is one of the most serious conditions affecting the proper operation of freight cars. He suggested as a subject for investigation how many railroads have proper yard facilities for testing the brake equipment and making necessary repairs to it. Referring to this matter, Mr. Tatum mentioned an instance in which a railroad was endeavoring to economize in the purchase of material by reclaiming old cylinder gaskets, no new ones being purchased. An inspection was made of some of the brakes thus overhauled after the work had been completed and the brakes stenciled ready to return to service; the fact was disclosed that the brakes leaked off so fast that it was impossible for the inspector to read the gage quick enough to say whether they had applied or not. A question as to the proper life of air hose in its relation to brake conditions was raised by H. C. Woodbridge, regional supervisor of the Fuel Conservation Section of the Railroad Administration, who stated that it costs as much to stop a train as to renew an air hose. This was cited as an indication of the false economy of attempting to retain air hose in service beyond the period during which they may reasonably be expected to remain tight. It was suggested that if road foremen and enginemen would report excessive train line leakage these reports might serve as a means of keeping the car department advised as to tendencies in the condition of air brake equipment. L. D. Gillette, inspector of the Canadian Dominion Railway Commission, also referred to the question of porous hose as being a source of great danger to the safe movement of traffic,—the proper place to locate the porous hose being in the yard and not on the road. In reply, Mr. Tatum stated that he considered the safe life of an air hose to be about one year, and referred to the fact that the Master Car Builders' Association is now considering the formulation of rules covering the question of air brake maintenance.

R. S. Miller, master car builder of the New York, Chicago & St. Louis, raised the question as to what constitutes a serviceable car. Various interpretations of this expression are being adhered to in different localities, which causes difficulty under present conditions in the free movement of equipment. If a uniform interpretation were available it would materially assist in securing unified inspection. Mr. Miller also advocated the universal use of the Master Car Builders' rules for the examination of car inspectors rather than the individual sets of such rules instituted by various car department heads. In answer to the question as to what constitutes a serviceable car, Mr. Tatum stated that he considered a car serviceable when it was in condition to carry the class of freight for which it was built, but that this did not preclude the use of box cars not in serviceable condition for first-class merchandise to carry rough freight.

W. H. Sitterly, general car inspector, Pennsylvania Railroad, emphasized the air brake situation, stating that the brakes contribute very largely to bad car conditions. The one difficulty is that time enough is not given to the car inspector to do his work properly, and it is also necessary that adequate time be given to making the needed repairs disclosed by the inspection. Cars should not be delivered in interchange with a clean bill of health merely to get rid of them. Facilities should be available for repairing the cars. There should be only about one and a half times the day's work ahead of the car repair forces and to keep within this figure adequate facilities and enough men must be provided. Great assistance in securing proper compliance with rules relating to car repairs in interchange has been rendered by the Railroad Administration in holding the individual responsible for failure to make needed repairs or for making improper repairs, instead of the matter being, as it formerly was, a subject for adjustment between the railroad companies involved. Mr. Sitterly referred to an analysis of 787 box cars which had been made at Buffalo to ascertain their suitability to be coopered for grain. Of these cars only 55 per cent were found fit to carry grain. He stated that this situation could be improved by using cars which were not suitable to be coopered for grain for loading such commodities as fertilizer, hides, oil, etc., which leave the car in a condition unsuitable for grain service.

In referring to Mr. Brazier's discussion Mr. Tatum called attention to Circular No. 20, which specified that when a car is repaired it should be put in service to give two years' service, barring accidents. In this connection he emphasized the need for more facilities. Operating officers and managers often complain about the condition of the equipment, but they seldom offer to furnish shop facilities adequate to carry out the amount of work which must be done to keep the cars from returning frequently to the repair tracks. It is not conducive to an ideal condition of rolling stock when a shop becomes somewhat congested with bad order cars to relieve the congestion by taking off the bad order cars without performing the work required.

T. J. O'Donnell, chief joint inspector, Niagara Frontier Car Inspection Association, referring to Mr. Tatum's statement that it should not be necessary to shop a car for defects that existed prior to the time of the last shopping, said that the Buffalo gateway had at least 1,000 loaded cars every morning, loaded from 24 to 48 hours earlier, which it was necessary to condemn, as high as 150 pairs of wheels having to be changed in one day. It is the endeavor at Buffalo to get cars through the terminal in three hours, but to do this the equipment must be in first-class condition.

A. R. Ayers, superintendent motive power, New York, Chicago & St. Louis, advocated the adoption of a regular periodical program of general overhauling of cars similar to that followed in the maintenance of locomotives. He also considered it best to allow the owning roads to handle the heavy repairs and betterments to their own equipment, as they are in a position to live up to the requirements of Circular No. 8. Furthermore, they are in a position to lay out the program for betterments to a whole class of their own equipment and then carry it out on a quantity basis rather than one car at a time. Mr. Ayers emphasized the need of carrying out such betterments by referring to a study which had indicated that steel cars or cars with steel frames came on the repair track on account of the draft gear less than once a year, whereas wood underframe cars appear on the repair track for the same class of repairs about two and a half times a year. In other words, it is a physical impossibility to repair a wood underframe car so that it will run two years, on account of draft timbers.

A question was raised if the Railroad Administration had any program in view for returning cars to the owner for such work. The difficulty of carrying out this work was indicated by the situation on the Delaware, Lackawanna & Western, which had less than six per cent of its own cars on its line, where formerly the average was 60 to 65 per cent. In answer to this Mr. Tatum called attention to the fact that cars can now be sent home at the owner's discretion when the cost of making repairs exceeds $200 and that cars on connecting lines can be sent to the home road for repairs. It is the policy of the Administration, however, that repairs be made wherever the cars are located when such repairs can be made in kind.

P. J. O'Dea, chief car inspector of the Erie Railroad, inquired as to what conditions had actually been found throughout the country and what might be expected in the future in the carrying out of betterment programs for equipment not now fully able to meet modern service conditions. In replying, Mr. Tatum called attention to the fact that the war had taxed the equipment as well as the other railroad facilities far beyond what has been considered its normal capacity. At the present time preparations are being made to carry out reinforcement programs on thousands of cars. It is, however, unreasonable to expect immediate results, as little of this work can actually be carried out within less than a year. Under present conditions it takes from three to six months to get together the material, such as center sills, bolsters, truck side frames, steel ends, etc., for a single lot of 1,000 cars. At the present time some 20 roads are preparing to reinforce about 20,000 to 25,000 cars, which will eventually result in an improvement in conditions.

INTERCHANGE OF FREIGHT EQUIPMENT*

BY J. C. O'DONNELL

The great volume of tonnage traveling through the country places upon us the responsibility as common carriers to handle that tonnage with despatch and due care. From the equipment point of view our first duty is to be absolutely certain that our mechanical inspection and upkeep are on a basis that will insure such service. This paper has been divided to cover points that are matters of daily observation with interchange inspectors, with the intention of creating discussion in order that we may take from it ideas that we feel will improve every day conditions.

THE HANDLING OF EMPTY FREIGHT EQUIPMENT

A car before it enters into interchange must first of all become a suitable vehicle for the load it is to carry, and upon this, barring unexpected conditions, depends its subsequent movement. To meet the requirements cars should be on the following basis:

A. Cars for grain or flour loading must be perfect as to roofing, flooring, sides and ends, clean and free from odors.

B. For merchandise, or similar loading, not susceptible to immediate damage, the roof in general must be free from leaks, but ordinarily not so close as an "A" car, and the body is acceptable for such loading if in fair condition.

C. For coarse freight loading, such as lime, ingots, spelter, pulpwood, and commodities not susceptible to damage by weather, the body should be in fair condition.

D. Open-top equipment in the ore loading districts and in season must have a special inspection to see that all sides and slope sheets are fit to withstand such commodity and that hoppers and attachments are in first-class condition and entirely free from defects. All other equipment of the hopper or gondola type for general utility loading may be inspected on the ordinary interchange basis with the conditions more or less perfect, but not with the special inspection required for ore loading.

The foregoing conditions from a mechanical standpoint will furnish the transportation department the equipment so that with little or no trouble it can be utilized for any purpose intended or desired. But let us not forget that the equipment must be carefully repaired after it has been thoroughly inspected for light truck repairs and work that seems to be overlooked as a general rule. I have in mind our vol-

*From a paper presented before the Car Foremen's Association of Chicago.

ume of empty refrigerator cars that should be specially handled before the load is placed in the car. This work should include not only the upkeep of air brakes, but also the arch bars, wheels, bolsters, draft rigging and all carrying parts of the car. To bring about such results there should be a systematic method of handling the empty equipment, preferably by the owners, when the owners are the loaders, or in immediate touch by the trunk lines, so that no car when the load is placed in it will necessitate repair track movement under ordinary conditions until reaching its final destination with the load in question. To illustrate the point I am trying to bring out for the benefit of interchange, for the month of December, 1918, in the Niagara Frontier district, the records indicate that our inspectors were obliged to condemn loaded cars to the repair track to the extent of having 1,200 pairs of wheels changed on eastbound interchange, and 20 per cent of this number were on high class freight carrying fresh meat, stock, poultry and similar commodities. This is one item alone out of our daily work that demonstrates the absolute necessity of doing all the necessary work on the crippled car before the load is placed in it for movement, and this must be done to get the service through on our high class special loading that invariably makes express time service.

NECESSARY ACTION ON LOADED EQUIPMENT BEFORE LEAVING THE INITIAL POINT OF LOADING

There must of necessity be close co-operation between the car department employees and the employees who are placing the loads in the car, both at freight houses, industrial plants and all other similar loading points, to see that the Master Car Builders' rules are strictly observed, both on open and closed cars, to protect the lading enroute from shifting and otherwise, and also on double and triple loads, to see that they are carefully built up to insure safe movement in line with the Master Car Builders' loading rules. These rules as in effect are revised from year to year and are perfect to cover the interchange throughout the country if strictly adhered to and carried out. The non-carrying out of these rules causes damage to lading, accidents enroute and serious delay, which could all have been avoided had proper care and supervision originally carried out the intent and purpose of the Master Car Builders' Association. I would especially call attention to the necessity of providing proper doorway protection and blocking on the closed car to overcome damage to the lading and injury at the doorway enroute.

The greatest responsibility of the mechanical department for protecting the lading is, first of all, to have a perfect car to put the lading in, and, secondly, to see when the lading is placed in the car by the consignor, that it reaches its destination and the consignee in the condition that it should, thereby overcoming, unnecessary expenditures to bring it back to its original condition.

INTERCHANGE INSPECTION FOR PROTECTION OF EQUIPMENT THROUGHOUT THE COUNTRY

Granting that we have complied with all of the previous requirements, the car is accepted for train service to its destination, and should proceed without serious difficulty. Primarily interchange inspection was intended for the purpose of a monetary protection on defects occurring through what we term unfair service that did not impair the strength or serviceability of the car, together with penalty provisions for not observing the requirements of selection as mentioned above. With the suspension of such service and the adoption of government control methods, there would naturally seem to be little use for interchange inspection, but when taken collectively the zones of our railroad centers are so distributed that when the equipment reaches these intermediate terminals it has covered, approximately, from 150 to 300 miles, and the service demands an examination of the running gear, a re-examination and repair of all air brakes and care and attention to lubrication and packing, which in the Niagara Frontier district, as a rule, is handled in about five minutes to a car.

The inspectors on the string as it reaches the receiving yard are two ground men, one roof man and two following-up men, and where the interchange demands it, the same number starting from each end of the string, except the roof man. At this time we inspect and condemn all handling line defects under government requirements, repair all yard defects, such as nuts on box bolts, carry irons, column bolts, draft pan attachments, also brake connection bolts and cotters, brake shoes and keys, brake hangers and parts, and all connections of the hand brake attachments. In many cases we apply brake beams in the train yard, in order to overcome switching any car to the shop track unless absolutely necessary. The finish of the string is then taken for switching and advanced to the receiving line yard as a rule, where the air brake test, repair and oiling is covered. The disposition of through business under such arrangements is based on the interchange of 8,000 loads and 3,000 empties every twenty-four hours, with an average of one car out of ten as a cripple to the repair track. This shows why we plead for better equipment at the initial point of loading, to overcome serious delays that must be faced enroute if such action is not taken, and which is kept constantly before us by our transportation department.

At this time I wish particularly to dwell upon the enormous losses through accidents that have occurred in our immediate district, where the old saying, "a stitch in time," is applicable. In going over some claims with the claim department of one of our trunk lines I was astonished to learn that during the year 1918 that particular line paid out, in the claim department, $5,619,000 to cover loss from accident, leakages, theft, improper stowing of lading and kindred causes. If each man takes pride in his position and is zealous to do his work without any sting of conscience, let us apply this principle to our trains enroute and not be charged with negligence that causes untold misery and loss of large amounts of money. In other words, if responsibility is ours, let us shoulder it and share it. This can only be done by every individual doing his full share both in the pit and in a supervising capacity.

I would strongly recommend that in order to have co-operation and a common bond of personal responsibility, frequent get-together meetings be held, bringing up points of self-interest for all concerned, which would bring about most excellent results.

We should not have any matters connected with the service that those associated with us are not thoroughly conversant with. The important duties the employees of our rolling stock departments are obliged to perform, should be an incentive for each and every one of us to give the very best that is in us to the railroads of our great country.

DISCUSSION

The discussion brought out many circumstances which hamper the repairing of freight cars at the present time. Mention was made of unsatisfactory labor conditions still existing and insufficient forces due to the reductions in the hours of service. Failure to authorize expenditures for betterments has resulted in the setting aside of cars requiring heavy repairs. The speakers agreed that there is much trouble due to the reloading of cars which are not fit for service but no method has been found by which this abuse can be controlled on industry tracks.

Some improvement has recently been noted in the condition of air brakes, but the tendency to neglect cars needing heavy repairs is causing a steady decline in the general condition of the equipment and cars are now accepted in general service that would have been carded bad order at the first interchange point under the standards in force a few years ago.

ENGINEHOUSE CRANES

BY E. A. M.

The following three types of cranes for use in enginehouses are in general use on one large road and have been found very serviceable and convenient.

POST CRANE

Fig. 1 shows a 2,000-lb. capacity post crane for roundhouses, which is generally located on the first post inside of outer wall of the house and is located on every post in that circle. In some cases possibly only a few located in some certain part of the house may be necessary, while in others it may seem most desirable on every other one. That is to be determined by local conditions and is, of course, optional with the user. The idea is to show a very good crane that has resulted in being a time saver for such work as lifting bumper castings, wooden bumper beams, front ends and doors, cylinder heads, steam chest lids, etc. By moving the smaller type engines forward in the house as much as possible, it is possible to lift air pumps by swinging the crane well back.

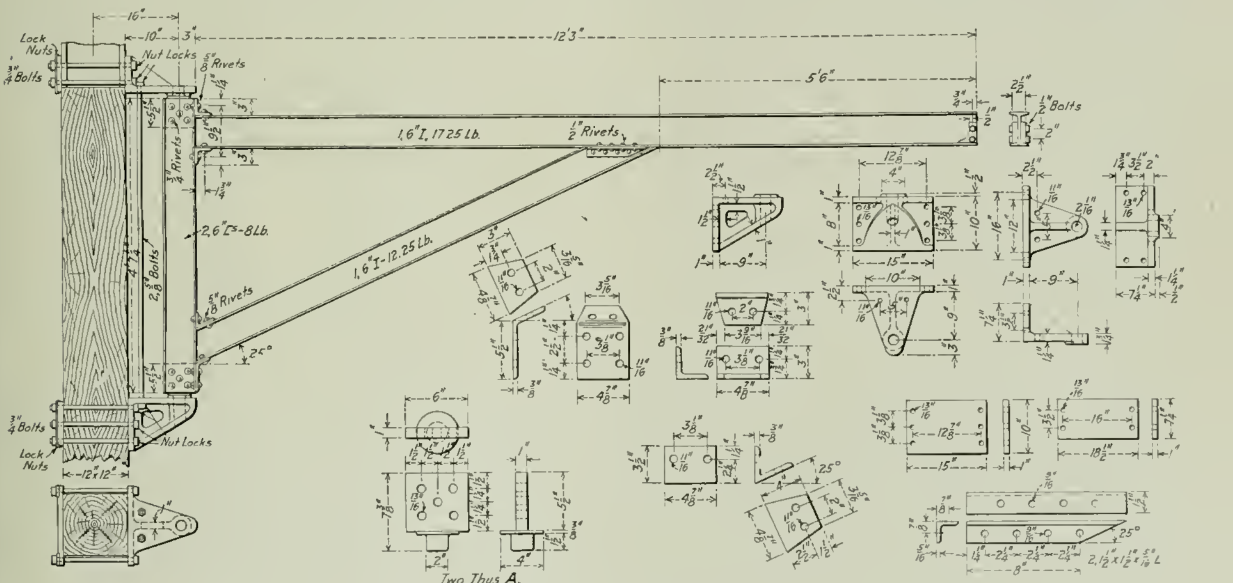


Fig. 1—Post Crane for Enginehouses

This is equipped with a 2-ton differential chain hoist on a trolley which has a movement of nearly 5 ft. The top I-beam is 6 in., weighing 17¼ lb. per foot and is 12 ft. 3 in. long; at the end there is a small casting on each side to prevent the trolley from running off. The brace is a 6-in. I-beam weighing 12¼ lb. per foot and the vertical pieces to which these are fastened by angle plates (riveted) are two 6-in. channels weighing 8 lb. per foot and 4 ft. 7¼ in. long. The castings (A) are placed between these upright channels at each end and have a circular base two inches in diameter, which extend into castings above and below, turning in them. These castings are bolted on the post with ¾-in. bolts, with plates on other side and nut locks are provided. Two ⅝-in. vertical bolts with lock nuts keep these castings a proper distance apart, or rather from spreading. Angles are used to secure the brace to the horizontal jib. The swinging axis is 10 in. in front of the post to give it greater range, in fact it has a range of about 284 deg.

In one of our roundhouses having 40 stalls, we have 39 of these, one on each post between the stalls, and nearly all are so provided, as a matter of fact all that are of any importance.

CRANE FOR LIFTING AIR PUMPS

A portable crane for lifting air pumps on or off engines is shown in Fig. 2. At times, when a locomotive comes into the roundhouse requiring repairs to the air compressor which require its being removed from the locomotive, this portable crane will be found very useful, and not only make a hard job easy but do the work with but a slight delay to the locomotive. The uprights are made of 2½-in. round iron pointed at the bottom for safety sake. These are amply braced by the ¼-in. by 1-in. pieces as shown. About 11 ft. 9 in. above the floor a weld is shown and the upper ends or pieces are welded to the 2½-in. uprights. These upper pieces are spaced ⅝ in. apart by the plate and washer, leaving a 5/8-in. space in center for the projecting or supporting arm which is shown as detail *A*. The piece *B* is bolted to this. The ends of this piece are about one foot apart and these rest on the handrail of the engine for support. You will note that there is plenty of space for lifting the pump as the connecting piece is 3 ft. 4 1/4 in. center to center. A suitable hoist is, of course, attached to the eye *C*, which has a trolley wheel. While this apparatus must be rather heavy in order to adequately support an air compressor, it can be easily handled by three or four men. The

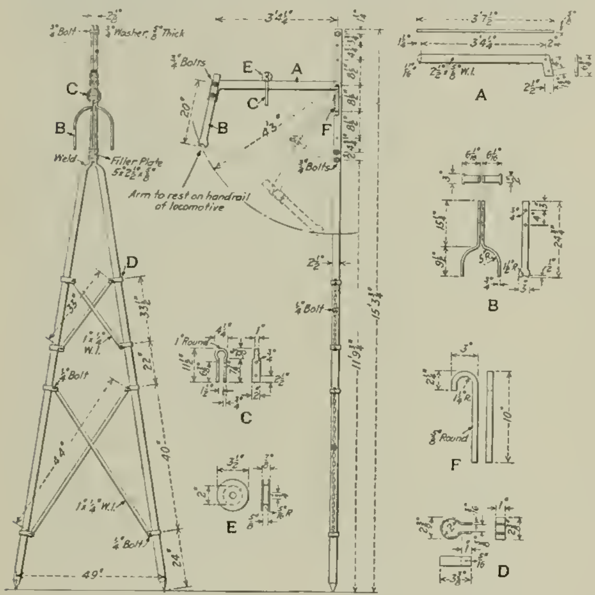


Fig. 2—Portable Crane for Mounting Air Compressors

swinging or supporting arm can be swung down to some extent, out of the road when not in use, as shown by the dotted lines.

STACK CRANE

Fig. 3 shows a locomotive stack crane which has been found very serviceable where other overhead or permanently

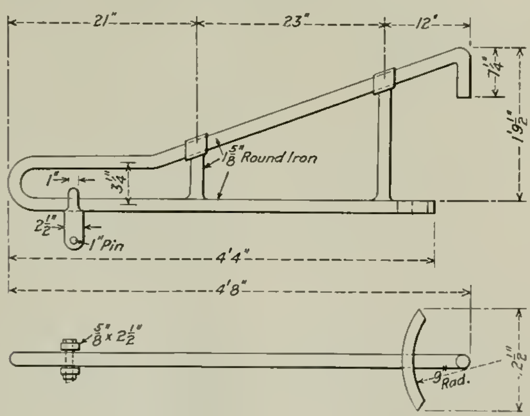


Fig. 3—Stack Crane for Locomotives

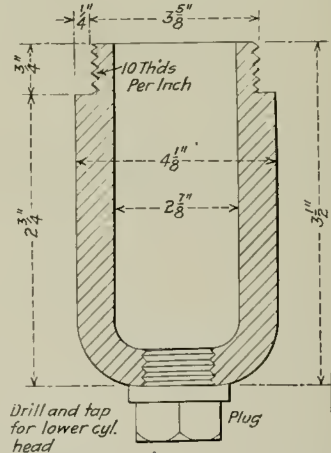
fixed cranes are not available. It is made up from 1 5/8-in. bar stock, as indicated in the illustration, the upper arm of which is bent over at the end to fit over the top of the stack. The horizontal arm has a curved rest, bent to a 9-in. radius, which fits against the side of the stack. The upper and lower arms are reinforced by two ties, also made from 1 5/8-in. iron, extended between them. The outer end of the frame supports an eye which carries a suitable chain hoist. This is free to move on the frame for a short distance, in order to get the proper location of the hoist. This is an excellent device for lifting heavy cylinder heads, steam chest lids, sections of cast iron bumper castings, wood bumpers, front ends, etc. Where other facilities are not provided it has been found very serviceable and will serve to materially shorten the length of time engines are kept in the roundhouse for repairs.

RECLAIMING LOWER HEAD OF CROSS-COMPOUND AIR COMPRESSORS

BY J. H. HAHN
Assistant Roundhouse Foreman, N. & W., Bluefield, W. Va.

One of the most common defects which develop in the 8 1/2-in. cross-compound air compressors is a broken piston rod. When the high pressure air piston rod breaks or the nuts work off the lower end, the result is generally that the pocket in the lower piston head in which the end of the rod works, is broken out. Ordinarily this starts the cylinder head on the road to the scrap pile.

The fitting shown in the drawing was designed for use in reclaiming cylinder heads broken in this manner and a large number of them have been applied with excellent results at Bluefield. The broken heads are placed in a large



Forged Fitting Used to Repair Broken Lower Cylinder Heads of Cross Compound Air Pumps

gap lathe and bored out and threaded to receive the fitting, which is forged from a piece of wrought iron and threaded as shown in the drawing. A large Stillson wrench is used to put the fitting in place, and it is set up reasonably tight. Heads thus reclaimed have been found to be as good as new ones.

Complete Locomotives Shipped to France.—The United States Army Transport Force has announced as one accomplishment under stress of war conditions the shipment to France of more than 400 American-built locomotives, weighing 73 tons each, completely assembled except for smokestack and tender and able to move under their own steam within a few hours after landing in France. The engines were shipped in special ships, each carrying 36 locomotives. About 1,200 other locomotives were shipped in sections easily assembled on the other side.

The Gas Welding of Thin Plates

Special Types of Joints Which May be Used, Some of Which Do Not Require Use of Welding Rods

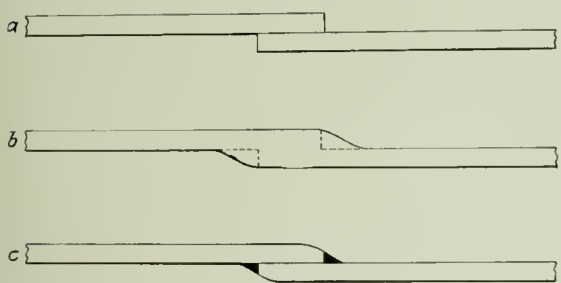
BY J. F. SPRINGER*

I.

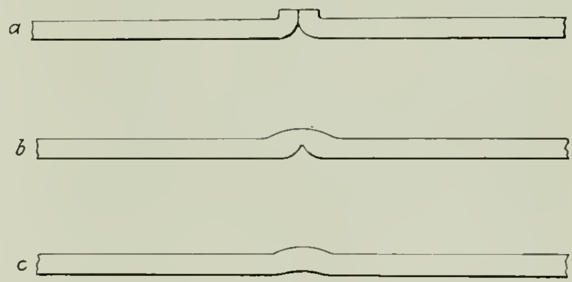
THE welding of plates not exceeding ¼ in. in thickness is an art in itself. Beveling, which is ordinarily so essential, is not always necessary or advantageous when welding thin plates, and with very thin sheets the highest temperatures are not desirable. But a shop using acetylene for general purposes may also find it advantageous to use the same equipment for thin work. The difficulty of uniting thin plates with an excessively hot flame lies largely in securing the necessary degree of rapidity and uniformity in the application of the heat. If the "hot spot" of the acetylene flame is advanced too slowly the edges of the work are apt to be melted away in places; if it is advanced too rapidly a good weld is not obtained. The operator must find the correct speed, taking into account the work in hand and the power of the torch. With thin work the necessary rate of advance will often be quite rapid, and it must be kept steadily at just the right rate. Furthermore, as the "hot spot" is not large, it becomes necessary that the torch be held at just the proper distance from the work.

It may seem that soldering and brazing would be preferable to gas welding as a means of joining thin sheets, and this is sometimes the case. However, soft solders are usually weak solders, and hard solders which possess high strength are not always convenient to use. An objection which applies to all solders is that they differ in character from the metal of the work, which means that the electro-potentials differ, and that under certain conditions electrolysis is to be expected. Thus, in the case of the thin steel sheets used in passenger car roofs electrolysis is to be feared if the joints are sealed with a metal differing from that of the work. With gas welding, it is usual practice to use the same or nearly the same metal for the joint as is to be found in the sheets to be joined.

The heat for soldering operations, especially where hard soldering is to be done, is not always conveniently applied. Thus, the case of the roof sheets for passenger coaches might present difficulty. This welding is done not for strength of joint, but for water-tightness. The edges of the sheets come together on the double flange of a T-bar and are riveted in place. Then the welding operation is carried out to seal the joint. The workman gets up on the roof and applies his torch. To do this job by brazing would probably be difficult, if not impossible. There are, in fact, so many cases where the oxy-acetylene and the oxy-hydrogen welding appliances may be taken to the job, that this alone gives the process a considerable advantage over brazing.



Plain Lap Joint



Modified Edison Joint

VARIETIES OF JOINTS

During the last 10 or 15 years, as gas welding has come more and more into commercial use, a variety of forms of joints suitable for thin plates have been developed. There are others which, although they have had no great test in actual practice, are worthy of consideration because of their conformity to requirements of the gas welding process. Some joints are good for one kind of service, but useless for another. Sometimes one joint is to be preferred to another not so much because it is a better joint, but because comparatively unskilled labor may be used in making it. Again, one style is preferable for certain jobs because it may be made accessible to the operator. In short, there are a variety of conditions surrounding individual jobs, all of which must be considered in the final choice of the type of joint to be used. But in all autogenous welding there is one rule which is quite generally applicable: Seek to locate joints away from corners. The object in removing the weld from a corner is to avoid the bending stresses to which corners are often subjected, but there may be exceptions even to this rule. In the case, for instance, of a tank with a bottom heavily dished inward, if the angle where the rim of the plate and the body of the cylindrical shell meet is sufficiently sharp, a weld where the edges come together may not be subject to appreciable bending stresses and such a joint may be permissible.

Plain Butt Joint.—The simplest joint is probably the one where the edges of the plates butt one against the other. The weld is made by melting the edges into each other and sometimes by the addition of new material. If the edges make a joint that is even and free from small cavities before heat is applied, there will be little use for a welding rod, unless it is proposed to pile up metal along the joint on one or both sides. However, where cavities exist, which will include the majority of cases, there will be more or less of a depression all along the line of the joint unless a welding rod is used to supply the extra metal needed. It may be added at the time the edges are melted together or put in place in a second operation.

The plain butt joint may be welded from both sides. This

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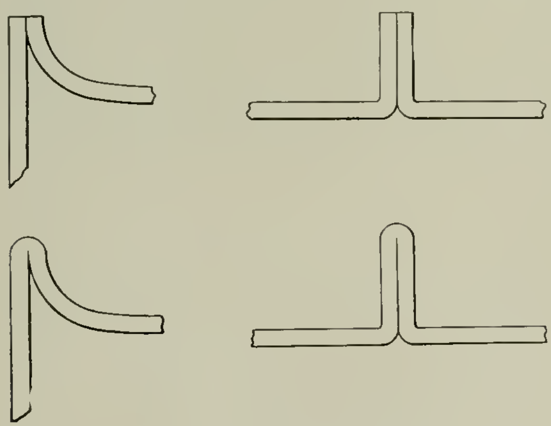
is often desirable and in some cases necessary. In welding from one side only it is necessary that the fusing temperature penetrate all the way through the full thickness of the plates to secure a perfect weld. Other things being equal, the difficulty of securing heat penetration will vary with the plate thickness.

It is possible to get welds without appreciable depressions, even though no rod is employed, by finishing the edges to make a close junction. The undesirability of a depression along the line of the weld depends on the service the work is to perform.

Beveled Lap Joint.—The edges of the two plates may be beveled and overlapped preparatory to the application of heat. The torch is to be operated preferably from both sides and the metal may be thickened by the use of a rod. If depressions are to be avoided when no rod is employed, the edges should fit closely to eliminate voids. If building up of the seam on both sides is carried out along the lines of the joint the two ridges of metal will not be directly opposite each other.

Beveled Edge Butt Joint.—In this joint the edges are brought up close together or even to contact. The rod is melted in to fill up the groove, and the groove is at the same time heated to the melting point. This particular joint is handled according to regulation methods used for general work, and the plates may be double beveled. The metal from the rod may be piled on one or both sides of the work. The groove, however, need not be as wide as in ordinary work.

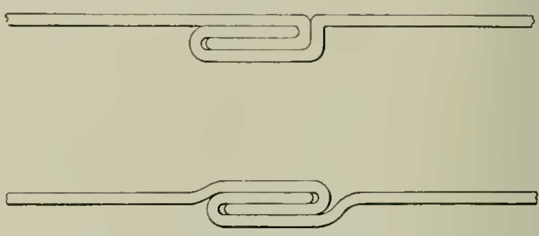


The Edison Joint

Plain Lap Joint, Without Rod.—With thin sheets one may simply be lapped over the other and heat applied to produce a molten condition over the entire area of contact. The question of thickness controls only to the extent that the torch may be limited in getting its heat through far enough. When working with metals which respond to old-time smith shop welding methods, light blows of the hammer may be employed to encourage union over the area of contact. Steel and nickel are such metals. The plain overlap may be especially useful where the two sheets are not of the same thickness.

There are cases where it is not necessary to secure the strength obtainable by melting the contacting surfaces into each other. In such cases the free corners of the overlapping plates may be welded on each side of the work. Where this style of weld is satisfactory from the standpoint of strength it may be carried out through a considerable range of thicknesses. In the diagram showing this modified plain lap joint, the darkened regions show metal that has been melted off the free corners and filled in the adjacent angles. Where rivets are depended on for strength and welding for the seal, this is a useful type. As no rod is required, the workman has his left hand free.

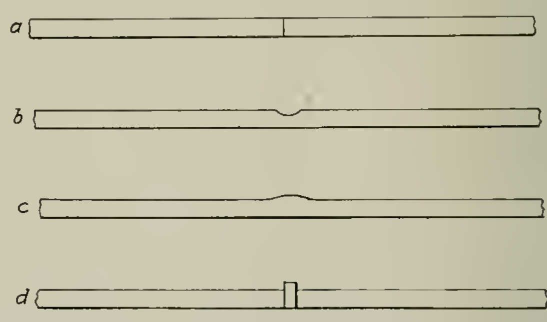
The Edison Joint.—In this type of joint the weld is made by melting together the edges of two plates lying alongside of each other. This joint secured its name from the fact that it was first used by the Edison Storage Battery Company in making storage battery cells. The metal in this case was thin nickel-plated steel, and the cell consisted of a rectangular shell with a single longitudinal seam and two heads of cup form let into the ends of the shell with their edges out.



Two Types of Folded Joints before Welding

The longitudinal seam was located on one side away from the corner.

This joint possesses a number of excellent features. It is easily prepared and easily welded, and as it requires no welding rod it permits the operator to have his left hand free. Considerable variation in the application of the heat is permissible, since there is a considerable margin in the amount of metal that may be brought into the weld. The effect of variations in the rate at which the torch is advanced and in the distance of the torch from the work will be evident only in irregularities in the profile of the finished joint which may be entirely satisfactory otherwise. The Edison joint is a good seam if the conditions of service do not produce stresses tending to open the joint on the unwelded side.



Plain Butt Joint, Showing the Effect of Welding Without or With Rod, and the Improved Butt Joint

Where such stresses are likely to occur the joint in its simplest form is not a suitable one.

Modifications of the Edison Joint.—Manifestly, it is not necessary that the bent-up portion of this joint be especially deep. In fact, the deeper it is the greater is the leverage tending to open the angle and break the weld. The bends may be reduced to a very slight depth, sufficient merely to supply metal easily reached by the torch. After the weld is completed it will, in such cases, show a protuberance on the operating side of the work and a groove or depression on the under side. The form of this depression depends on the sharpness of the bends and on the penetration of effective fusing heat. A groove in the shape of a narrow and deep indentation may for certain classes of service be objectionable as defining a line of breakage. The groove may be modified by applying a welding heat on this side of the work and totally eliminated by using a welding rod. Where the welding rod is not used, the form of the joint may be further modified by the use of the hammer. This provides a method of securing the full thickness of metal at the joint without using a welding rod.

The Improved Butt Joint.—Welding without rod is advantageous in working on thin plates, because it releases the operator's left hand to assist in steadying the torch, and because the new metal may be otherwise provided in a manner insuring a uniform amount all along the seam. This latter point is at times important where uniformity of appearance is desirable. Thus, with the Edison joint, where the bent-up portions are shallow, they provide the new material in a way to meet this requirement. The same result may be secured by another method which may be easier to carry out under some conditions. The edges of the sheets are left square as if for a plain butt joint. But instead of putting them in contact with each other, a thin strip of metal is set between them. This strip is wide enough to extend slightly above the surface of the sheets. When the weld is made the strip is melted into the edges of the sheets and the whole region consolidated. The amount of new metal added depends upon the extent to which the inserted strip projects above the surface of the sheets.

A modification of this type of joint requires the strip to be set so as to project on both sides of the joint. There are then two heating operations.

The Folded Joint.—Where the plates are very thin and it is not difficult to provide for the penetration of a fusing heat through several thicknesses of the metal, a folded joint may be used. There are two principal forms. In one both sides of the work disclose an increase in thickness; in the other this shows on one side only, the other side remaining flush with the general surface. The illustrations show clearly the manner of folding for each of the forms. It should be noted that where the former type is permissible, both sheets are folded alike, thus simplifying the preparatory work. This style of weld requires a considerable degree of skill. First, the thinness of the sheets requires prompt and uniform action on the part of the welder. Second, enough heat has to be supplied to secure intermingling. The skill required may be reduced somewhat by applying the heat in two operations, first from one side and then from the other, and by using the hammer to assist the union. In any case, however, it is not a job for a beginner.

(*To be concluded.*)

RECLAIMING BUSHINGS FOR 9 1-2-IN. AIR PUMP REVERSING VALVES

BY J. H. HAHN
Assistant Roundhouse Foreman, N. & W. Bluefield, W. Va.

A set of tools has been developed at the Bluefield shops of the Norfolk & Western, by which it is possible to reclaim successfully the reversing valve bushings for Westinghouse 9½-in. air pumps.

By referring to the drawings, which show the details of the various tools, the method of using them may very readily be explained. It is first necessary to remove the dowel in the reversing valve bush. After this has been done the arbor *A*, Fig. 1, is then placed in position in the bushing. The washer *B* and nut *C* are then placed on the end of the arbor and the nut securely tightened. Next the reamer *D* is placed on the arbor, followed by bushing *E*. This bushing has two lugs on each end, which fit in the slots in the end of the reamer. The split driving nut *F* is then placed in position, on the threads of the arbor, inside of sleeve *G*. The wrench *H* is placed over the sleeve, the projection on the side of the latter fitting in the slot in the wrench, which is finally secured in place with a ⅜-in. set screw.

With this device the bushing is then reamed out to fit the next larger size of reversing valve, which, as shown on the drawing, Fig. 1, is 1 13/32 in. After this reamer has been driven to the bottom of the bush a 1 7/16-in. reamer is placed on the arbor and driven down about 1/16 in. below the first port in the reversing valve chamber bushing. This gives the valve the proper clearance and prevents it from wearing a shoulder in the bushing, as is usually the case.

After the bushing has been reamed the dowel is replaced from the inside, using the tapered wedge shown in Fig. 2, or the special dowel replacing tool shown in Fig. 3.

The latter tool has a cylindrical body 1⅜ in. in diameter, which is made in two parts dovetailed together. Extending through the body longitudinally is a tapered hole in rectangular cross section, in the bottom of which is drilled a hole

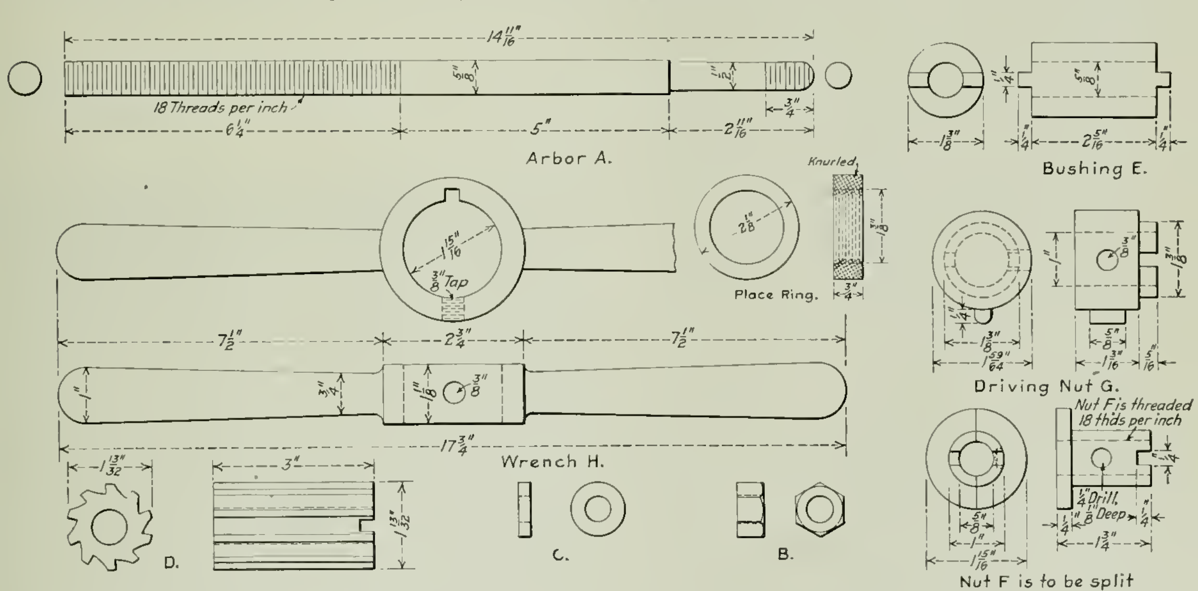


Fig. 1—Details of Special Tools for Reaming Out 9½-Inch Pump Reverse Valve Bushings

to fit the 5/16-in. dowel. A plunger of the same size is placed in this hole from the inside and a tapered wedge driven between the plunger and the tapered side of the hole in the body of the tool. With the device in place inside the bushing it is thus possible to drive the dowel into place. The

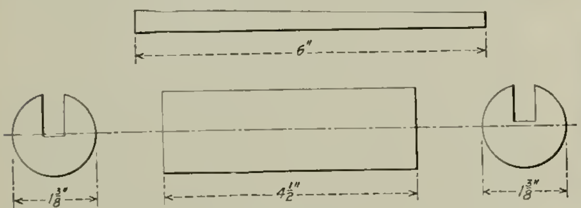


Fig. 2.—Simple Wedge for Replacing Dowel Pins in the Reamed Bushings

slot in the body of the tool permits it to be slid into place over the end of the dowel.

Special reamers of the shell type are used, which may be ordered from manufacturers or made in the shop. Aside from the reamers the tools shown in the drawing were all

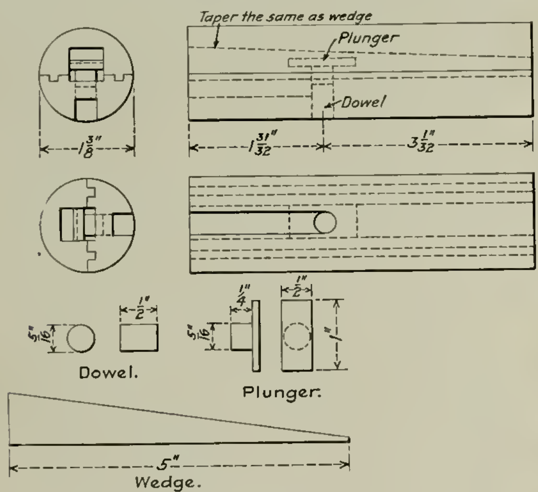


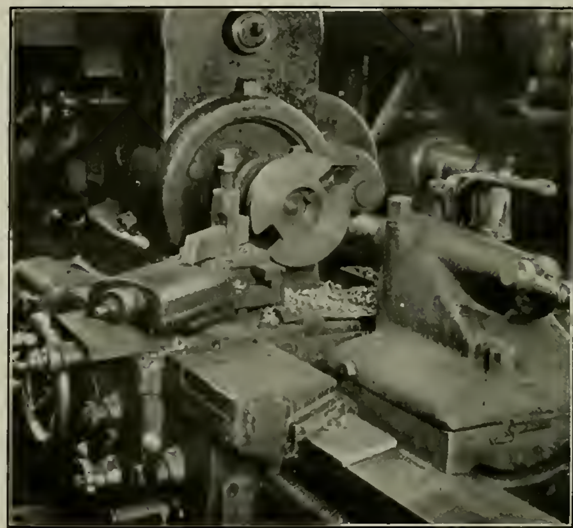
Fig. 3—Another Type of Dowel Pin Replacing Tool

made by apprentice machinists from scrap material. A discarded piston rod from an 8½-in. cross-compound pump furnished a good grade of steel for this work.

INCREASING PRODUCTION ON BOLT LATHES

In the illustrations shown below are shown two devices applied to a portable lathe in the Beech Grove shops of the Chicago, Cleveland, Cincinnati & St. Louis which will save time on any lathe used for turning bolts. The chuck shown is simple but nevertheless very effective. It screws on to the spindle and projects beyond the center with a recess to receive the head of the bolt. Extending into this recess is a set screw which can be tightened to grip the head of the bolt. In practice the screw is run up so that it just clears the flat on the head when the bolt is on the center. The bolt can then be inserted but cannot turn in the chuck. The flange of the chuck extends beyond the head of the set screw in order to keep it from the possibility of catching the clothing of the operator.

The indicator shown in the illustration of the tail stock is a great convenience for setting the center where one standard taper is used. The arm is L-shaped and is pivoted at the angle on a stud in the top of the tail stock. The short vertical arm bears against a stud in the base, the point of contact being at a point that causes the pointer to move about 18 times as much as the tail stock. This lathe is used



A Safe and Convenient Chuck for Bolts

only for cutting the standard bolt taper of 1/16 in. to the foot. The indicator is adjusted to show when the lathe is turning straight; then it is set to give the proper taper for a bolt 12 in. long, and these points are marked on the brass

Indicator on Tail Stocks for Setting to Turn Standard Taper

plate at the end of the indicator. The distance between the marks is then graduated to show the setting for bolts of any intermediate length. This attachment saves a great deal of time in setting the lathe and it has been found to be very much more convenient to use than the standard taper attachment.

How Joe Harris Saved His Job

It Was "Up to Him;" He Learned That Courage Is an Essential Quality of the Successful Foreman

BY A. J. TEN CATE

It was Monday morning and although the 6:45 whistle had not yet sounded at McGregor shops, there was a gathering of unusual numbers around the shop bulletin board.

As each new-comer arrived he was instantly attracted by the crowd rapidly assuming large proportions in the center of the shop and naturally gravitated in that direction to ascertain the cause of the excitement. Sometime since Saturday afternoon a bulletin had been tacked on the board which read as follows:

TO ALL SHOP AND ROUND HOUSE EMPLOYEES

Mr. Joseph B. Harris is hereby appointed General Foreman at this point with jurisdiction over shops and round house.

Signed: H. L. BROWNLEE,
Master Mechanic.

Not that bulletins announcing the appointment of a new general foreman were of such rare occurrence as to cause wonder or even interest. The men in McGregor shops had long passed that stage. More general foremen had been appointed there during the past three years than at all other points on the road combined, and the new bulletin was the third notice of a similar nature in eighteen months. As each man who had held the job severed his connection with McGregor—invariably by request—the only comment heard around the shop was, "Who is the next victim?" and when that worthy put in an appearance it never caused even a ripple of excitement.

This morning, however, the usual order of things was reversed and an air of expectancy prevailed. Many and varied were the comments that came from the swelling crowd around the bulletin board. There were hoots and howls, cat calls, groans and much laughter. "Wait till old Hank sees it," said some one. "Hank'll explain what'll happen to him." This brought a yell of delight from the throng.

"Here's Hank now," shouted a man on the edge of the crowd, and all eyes were turned toward a tall, sinewy man possibly 55 years of age who, as he walked toward the crowd, wore an air of aggressiveness which indicated a determined and rather belligerent character.

Hank Hazard had been the rod shop foreman at McGregor for many years. A first-class mechanic and possessing marked executive ability, it was said of him by those who knew him best that had he been less aggressive in temperament he might easily have been a master mechanic many years ago. But Hank, while a good friend and with many traits of character that made for him a host of friends among the shop men, had the unfortunate habit of treating his superiors in a manner that always gained their dislike. Hank instinctively hated a new boss, and usually made it a point to let it be known. Yet he could be loyal, and when his support was once gained, as in the case of Mr. Brownlee, the master mechanic, who had been able to gain Hank's respect at the start, there was no task too big for him and his gang to undertake. It was claimed by many that when Mr. Brownlee was appointed master mechanic he owed his promotion from general foreman to Hank Hazard more than to his own efforts.

Hank wielded a powerful influence in the shop, and new general foremen usually tried to "get something on him" in order to fire him rather than to turn his influence to their own advantage. Perhaps it was natural that his regard for officials in general, and general foremen in particular, grew less and less as time went on, and his attitude toward a new foreman was always awaited with eagerness by the men.

So it was on this morning, and everybody expected some especially vitriolic remarks owing to the fact that the appointee was the last man any one in McGregor had expected to see in the position.

As Hank arrived the crowd made way for him so that he could read the bulletin. "What's up?" he asked, curtly, as he set down his dinner pail and adjusted a pair of steel-rimmed spectacles preparatory to reading the notice. A strange hush now pervaded the place where but a moment before so much excitement reigned. The crowd waited expectantly for an outburst.

"What's that?" said Hank, as he read the name, "Mr. Joseph B. Harris. Where did *he* blow in from?"

Not a man answered. They had expected Hank to catch on immediately, but apparently he had utterly failed to grasp the significance of the bulletin.

At last someone ventured, "Don't you know him, Hank?"

Realizing that somehow he had missed the import of the notice, which the boys seemed to understand, he read it again, this time more deliberately. Suddenly the truth flashed upon him and he turned abruptly to the men, with a flush on his face.

"Do you fellows mean to tell me that Mr. Joseph B. Harris is Joe Harris—our Joe?"

"Sure, Hank, that's who it is, all right."

"Well, if it is," said Hank, "it means another dead cock in the pit," and, picking up his pail, he started for the rod shop amid a roar of laughter as the 7 o'clock whistle blew and the men dispersed to begin work.

Old Ned Hanlon, the chief clerk, was busily engaged in sorting the night's accumulation of messages in the general foreman's office. As he finished his task he handed them over to a tall, broad-shouldered young man who was waiting for them. "There you are, Joe—I mean Mr. Harris," said Ned, half apologetically, as he handed over the last message.

Ned's attempt at being respectful was not lost on the new general foreman, who understood perfectly what was passing in his mind. Instinctively he knew what was passing in the minds of everybody in McGregor shops that morning, and as he turned to leave the office he felt his courage rapidly vanishing, and he began to wish he had refused the promotion Mr. Brownlee had persuaded him to take.

The ordeal was a hard one for Joe Harris. Born and brought up in McGregor, he was known by every kid in town as just a big, good-hearted, overgrown boy, bubbling over with good nature, always ready to help anybody, and everybody's good fellow. Not an enemy in the world, for who could dislike such a personality?

And Joe was a mechanic. There was no doubt of his ability in that line. When it came to understanding the locomotive and shop work, he outranked them all. He had served his time in McGregor shops, and long before he had completed his full apprenticeship he was regarded as a genius from a mechanical standpoint. His capacity for knowledge was extraordinary, and he easily led his classes in every department.

No sooner was he out of his time than he was placed in charge of the valve gang in the roundhouse, and his fame as a valve setter soon spread on the three divisions centering in McGregor. His unusual mechanical ability, together with his good nature, quickly made him the most popular man in the terminal. His knowledge of the work in every other department was remarkable, while he knew more about what was in the storehouse and the different classes of material than the division storekeeper himself.

But Joe was no man to handle men. Everybody's good fellow makes a poor boss, and he was no exception to the rule. There wasn't a day he didn't do twice the work of any of his men. Young, strong as an ox, he seldom asked a man to do what he could do himself and, as is usual in such cases, many imposed on his good nature.

However, it was not long before Joe was placed in charge of the valve work in the back shop, and he was holding this job when he was appointed general foreman. When he was first offered the place Joe promptly refused it. To take charge of McGregor shops, full of old men, many of whom he had served under, looked too big for him. Then, too, he knew to be successful as a general foreman at that point meant a man capable of using the iron hand frequently, for discipline was a thing long unknown in McGregor.

Time was, Joe remembered it, when every man took pride in his work. Gang vied with gang in good-natured rivalry in swelling the output. Those were the days when 25 to 30 engines per month was a normal output.

But those days were gone. The loyalty for which the shop was noted was a matter of history, now almost forgotten. Many general foremen had come and gone during those years. Some had "finished quick," as old Hank Hazard put it when speaking on the subject, which was always a bitter one for him. Most of them were unfitted for such a position, and the men were never long in finding it out. It all had a demoralizing effect on the personnel. Discipline, interest in the work and loyalty, the three great shop essentials, disappeared. Output dwindled and costs soared. Mr. Brownlee, long noted for his organizing ability, came in for much censure from the management, and the superintendent of motive power came to McGregor frequently because of the poor showing at that point.

Naturally, McGregor shops had long since gained an unenviable reputation. Things went from bad to worse and finally came to a climax when in desperation the superintendent of motive power sent a new man to McGregor as general foreman, who started in by firing some of the best men in the shop. This gained for him the enmity of every man in the organization, a feeling which was increased as it became known that his experience was limited to a year or two on special work after serving a special apprenticeship on another road. He had never even had charge of a shop gang prior to his advent at McGregor as general foreman, and had secured the position through the influence of a friend of the superintendent of motive power.

At the time this man came on the job the road was doing a very heavy business. Power was required as fast as it came in, and any slowing up in engine despatching promptly blocked McGregor yard. At such times co-operation must exist throughout all departments, and the lack of it soon developed a crisis at McGregor so acute that the general manager went there to investigate.

The new general foreman, unmoved by the fact that things were tied up, and not knowing the general manager was on his way to the shop, was sitting in his office smoking a cigarette and reading a newspaper. As the general manager entered the door the young man presented a picture of indolent ease. Not dreaming the identity of the general manager he simply bestowed a "well, what do you want" sort of stare on that official, who sized him up as a clerk and asked, "Where is the master mechanic?"

"I have no idea," replied the general foreman, as he flicked the ash from his cigarette.

"Well, you look it," said the exasperated official, and he turned to go out just as Ned Hanlon entered the door. Ned was recognized by the general manager, who asked him where the master mechanic or general foreman could be found.

"Why, this gentleman is the general foreman," Ned replied, pointing to that worthy.

The general manager immediately turned to him and said: "If you have been running the power here I don't wonder we are tied up. I think we can dispense with your services."

When this occurred it was generally understood that Mr. Brownlee had been given one more chance to straighten out McGregor, and it was at this time that he sent for Joe Harris.

At first Joe refused to consider the offer, but Mr. Brownlee was insistent. He told Joe what his refusal meant to him personally, for it was up to him to put a man in charge whom he could trust, and Joe was about the only man fitted for the position who answered that requirement. It meant a big future for Joe, too, if he made good, and there was no reason why he could not do so. He reminded Joe of his mother and family, who relied on him for support, and this helped to persuade Joe to accept, for his expenses had always been so great that he had been unable to save anything.

As Joe walked into the shop this Monday morning he recalled all this and keenly regretted his decision. He suddenly saw the colossal nature of the task before him. Scarcely a man was at work; his appearance was a signal for what few who were busy to stop their work and exchange views with each other. That the place was demoralized he had known for a long time, but somehow he had never thought it was as bad as he now saw it to be.

Some of the men that first day showed a desire to respect him, at least in his presence. Some were openly defiant, while others ignored him altogether. Joe Harris as a workman was all right, but as a general foreman—why, he was nothing but a joke. The idea of taking orders from him was, to most of the rank and file, ridiculous. Many of the old men resented his appointment, and did not take the pains to conceal their feelings. And so Joe started in with his former friends and associates for the most part arrayed against him.

As was usual with him Joe did not spare himself, and was soon a slave to the job. Mr. Brownlee frequently warned him of his mistakes in this line, but in spite of all the advice given him Joe plodded on. He knew instinctively he was losing headway, that things were getting worse every day. He had never dismissed a man, nor had he censured a foreman. In his good-natured, whole-hearted way he had reasoned that his former friends would rally around him when they found that he was just the same old Joe. But he erred sadly in this respect, as many men have done before him.

Mr. Brownlee finally lost patience with him and often criticised him bitterly.

It was the 20th of the month, and the prospects for shop output were dark. Engines on the road were constantly falling down, and so many men had to be sent to the roundhouse to keep power repaired temporarily, that output was lost sight of entirely in the shop. Never had so much overtime been paid, and conditions generally were the worst in the history of the shop.

About 3 o'clock Mr. Brownlee sent for Joe after a long-distance 'phone conversation with the superintendent of motive power. As Joe entered the office that afternoon Mr. Brownlee arose from his desk and said to him: "Mr. Harris, I have called you here to tell you that my resignation is expected the first of the month if things don't improve. It is safe to say they won't improve, and you are the cause of it all. You could hardly have done more to hurt me if you had tried. Mr. Harris, you are a coward."

Joe stood speechless before his accuser. The words burned into his soul.

"A coward," went on Mr. Brownlee, "is a man afraid to do his duty, and that is exactly what you have failed to do, because you were afraid of your men. Instead of making men respect you, and the position you hold, you have simply done the work, what little there has been done, and your men have stood around and had a good time. The best equipped man for the job on the system, you have proved to be the worst selection that has ever been made."

Joe knew he was hearing the truth; he realized he had failed, and for the first time he understood what it meant to the man who had tried to be his friend. As he rapidly called to mind the attitude of his men, their indifference, their utter disregard of instructions and their disloyalty, his blood boiled within him.

Suddenly turning to Mr. Brownlee, a new light shining in his eyes, he said huskily, "Is it too late? I want just one week more."

Mr. Brownlee noted with surprise his changed appearance. "All right," he said, "I'll give you one week more."

As Joe turned to leave the office he paused at the door, and then suddenly faced his chief. "Sir," he said, "one week is enough. If I don't get a move on things before that time, I, too, am ready to leave," and with this remark he left the office.

As he passed out to the shop he met one of his erecting foremen who asked Joe to accompany him to an engine in the roundhouse where he had some men making repairs which were giving them some trouble. Joe scarcely heard what the man said to him so deeply absorbed in thought was he, until he arrived at the engine. He then became aware of the presence of some men under the engine, whose conversation brought him to himself with a jolt.

"Well, Jack," said a voice, "we've been here now an hour and h'aint done anything but smoke cigarettes. Now they are all gone I am going home," were the first words Joe caught.

Laying his hand firmly on the arm of the foreman, who was about to call out to the men, Joe enjoined silence.

"All right," answered the second voice, "I'm with you, old-timer; gets tiresome hanging around in a pit waiting for the whistle. Some dump," went on the voice, "and always will be until they get a general who is one."

"Why, say, Jack," said the first speaker, "our gang h'aint done a day's work this month, and overtime! why, even I am ashamed to take the money, and you know I ain't no saint."

Joe fairly quivered. "Call them out," he said to the astonished foreman, who had never seen Joe Harris look like that before.

As the men crawled out from under the engine Joe recognized one of them as a man he had befriended only a short time before.

"A fair return you have made to me," he said, "but at least you have given me the opportunity I am looking for. Mr. Leslie," he said, turning to the foreman, "you heard what they said; you probably know it is true. You will not only dispense with their services, but you will see to it that their service record shows 'dismissed' and not 'resigned,' as has been done in the past; for they're fired." With this remark Joe started for his office.

A few moments later old Ned Hanlon, with an air of suppressed excitement, went through the shop and personally notified every foreman in McGregor to attend an important staff meeting at 5 o'clock that afternoon. No excuse would be accepted, Ned whispered he had been instructed to say, for failure on the part of any foreman to attend. The dismissal of the two men, quickly followed by a hurry-up call for a staff meeting, caused a sensation in the shop. The fact that Joe Harris had fired anybody, in itself was enough to start speculation.

"Something doing," was the unanimous verdict, and everybody was on edge.

Promptly at 5 o'clock the foremen filed into the large staff room over the office, where Joe, with cheeks flushed, was sitting at a table looking over some papers, while at his left was a stenographer from the master mechanic's office.

As he called the meeting to order, Joe noted that every foreman was present. "Gentlemen," he said, "I want you to listen to some letters." The stenographer then read some letters from the superintendent of motive power, two of which cited figures to show that McGregor shop was in worse condition than ever before. Joe waited impatiently, it seemed to the men, until the last letter was read, which concluded with "the conditions now obtaining at McGregor shops are a disgrace to this department and must not continue. Please advise at once what you purpose doing to effect improvement." Apparently this was what Joe had been waiting for.

"Gentlemen," he said as the letter was concluded, "I have advised Mr. Brownlee to answer that letter by saying that an immediate improvement may be looked for, and it is my intention to make good that promise. In the two months I have held this position I have tried to work with you all, hoping and believing that I might succeed in getting your co-operation. I reasoned that I had a right to expect it, but you failed to see it in that light. My attempts at bringing about an improvement have not only failed, but, as the records show, we have steadily grown worse, and at the present time we are far below the percentage we were making when I took the job. Every order I have issued has been a signal for even greater violations of the particular condition the order was designed to remedy. Overtime has doubled, although I have repeatedly called your attention to the necessity of reducing it. Repairs are made in a superficial manner, and men are allowed to do as they please. I have regarded you all as personal friends; you have treated me as an enemy. My predecessor was cordially hated by you all, and no effort was made to co-operate with him, yet his record is far ahead of mine. The last month he was here there were 15 general repairs turned out of the shop; if we get 13 this month it will be a surprise to me. Such, gentlemen, are the conditions which I have agreed to remedy."

As Joe faced his foremen there was an air of calm defiance about him no man had ever seen before. Joe Harris, the good-natured boy, had somehow disappeared. Joseph Harris, the man, a real general foreman who knew the game, stood before them.

"Gentlemen," he went on, "from this hour the slogan is 'Get Busy.' Each of you will have a copy of some instructions, on your arrival tomorrow morning, that mean business. I shall see that they are carried out. Engine failures and overtime will be reduced and output increased from now on. In conclusion, if there is a foreman present who does not want to start tomorrow morning with a firm and honest desire to work with that end in view and carry out instructions, I hereby ask him or them to resign here, tonight. Tomorrow will be too late."

Every eye in the room was fastened on Joe as he waited a moment before proceeding. "Very well," he said, "before we close, has anyone anything to say?"

Instantly Hank Hazard was on his feet. "Mr. Harris," he said, looking at Joe with an expression on his face no one ever remembered seeing before, "I want to take this opportunity to say that I for one am heartily ashamed of my record during your term of office, and I am likewise ashamed of the record of the shop and every man in it. We all needed just what you have handed to us, and I don't believe there is a man here who won't give you his hand and promise results from now on, and just to put it to the test I am going to take the lead," and Hank walked up to Joe and extended his hand. Every man in the room fell into line behind him, and each gave Joe a hand clasp that was genuine.

An air of unusual bustle and activity prevailed in the shop long before the whistle blew at 7 o'clock the following morning. Most of the foremen had congregated early in the rod shop where Hank was busily engaged figuring out some calculations on the back of a blue print. "It's got to be done, boys," said Hank when they separated as the whistle stopped blowing, "don't fail."

As Joe Harris passed through the shop next morning he was quick to note a great change that had already been made. Every man was at work, every foreman on the job. That afternoon he met Mr. Brownlee, who simply held out his hand and said, "At last, Joe, at last; I knew it was in you."

Never was the slogan, "Get Busy," so faithfully carried out. Partly finished engines lying in the shop and not included in the schedule for that month began to take definite shape and were added to the schedule. In the roundhouse when engines were held for boiler wash, the rods, motion work and wedges were thoroughly gone over, and engine failures soon began to decline. Overtime in all departments was cut in half the first week. When the last of the month arrived there had been 16 engines turned out of the shop with a general overhauling, but Hank Hazard kicked because it wasn't 18, the number he had figured on.

Joe held frequent staff meetings, and every foreman was asked for ideas. These meetings brought immediate and profitable results. Every man in the shop took a personal interest in production. From the worst managed and most expensive shop, McGregor was soon looked upon as the best handled point on the system. From 15 engines a month, the output grew to 20 general repairs turned out regularly. Engine failures had practically been eliminated. How it was all brought about was a mystery to the management.

One day the superintendent of motive power came to McGregor and, after a talk with Mr. Brownlee, sent for Joe.

"Mr. Harris," said he, "there is a vacancy for a master mechanic on the Eastern division, and I want you for the place. Your record here the past three months, which, I will say, is unparalleled in my experience, justifies me in offering you the position. Bad as you are needed here it is only simple justice to recognize what you have done. My only concern now is, who will be your successor. Can you suggest a man?"

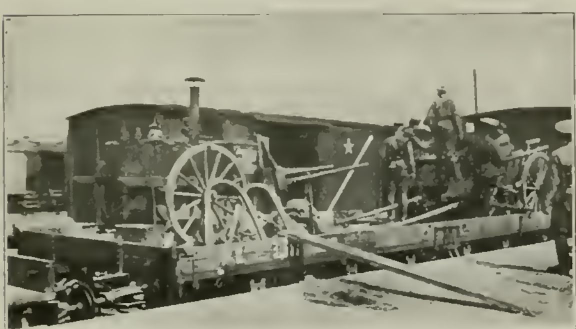
"I can," replied Joe, looking the superintendent of motive power squarely in the eye, "and a man who will continue getting the same results, if not better, than we are now getting."

"Does he work here, Mr. Harris? If he does, by all means, Mr. Brownlee," turning to the master mechanic, "let us give him the place. Do I know him?" he asked, again turning to Joe.

"Yes, sir," was the reply; "you have known him many years."

"Why, who can he be?"

"His name is Henry Hazard," said Joe.



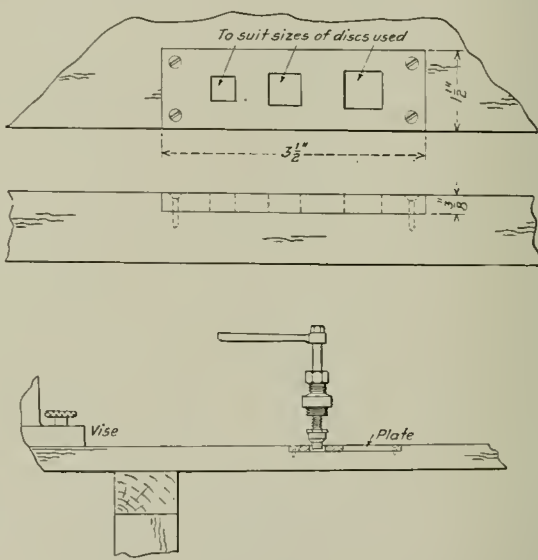
Railroading in Siberia

A CONVENIENT FITTING FOR THE INJECTOR REPAIR BENCH

BY F. W. B.

A very simple and convenient facility for the injector repair bench may be made by inserting a ⅜-in. steel plate, through which a number of square holes of suitable sizes have been cut, in the top surface at the edge of the bench. For the greatest convenience the plate should not be located far from the vise.

Where the injectors are fitted with valves of the disk type,



Bench Chuck for Removing Injector Disc Valve Nuts

the disks of which are held in place by nuts, it would ordinarily be necessary to place the nut in the vise when removing it, or when tightening it after the disk had been replaced. This is an awkward operation which in nearly every case can be dispensed with by the use of this simple device. All that is necessary to remove or tighten the nut is to drop it into the hole of the right size in the steel plate and the nut is thus held while the valve stem is unscrewed or tightened, as the case may be. Only occasionally will nuts be found so tight that the vise must be used.

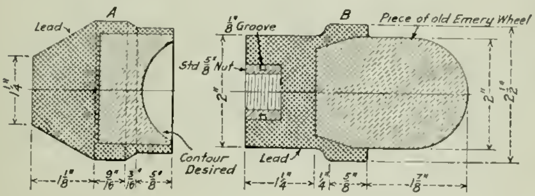
GRINDERS FOR SUPERHEATER UNIT JOINTS

BY H. P. MAUER

The drawing shows a set of shop-made grinders for superheater unit joints which are made from pieces of old emery wheel imbedded in lead or babbitt. The concave grinder is designed to fit the chuck which is in universal use for this work, while the convex grinder is provided with a ⅝-in. nut in which may be screwed shanks to fit any machine that may be used to drive the grinder. The grinders are made by placing suitable pieces of broken emery wheel in a suitable mold and then pouring the lead or babbitt around them.

In the case of the concave grinder the chuck fit is machined after the body has been cast, and after the grinder has been clamped in the chuck the contour of the grinding surface is finished with an ordinary emery wheel cutter. In casting the body of the convex grinder a standard ⅝-in. nut, around the body of which a groove has been cut, is placed in the mold to form the means of attachment for the driving shank. As in the case of the concave grinder, after the body has been cast the grinding contour of the emery stone is finished by the use of an ordinary emery wheel truing tool.

These tools were developed by A. Jiminez, roundhouse foreman of the Cuba Railroad at Camaguey, Cuba, and the tools have been in successful use at this point for five

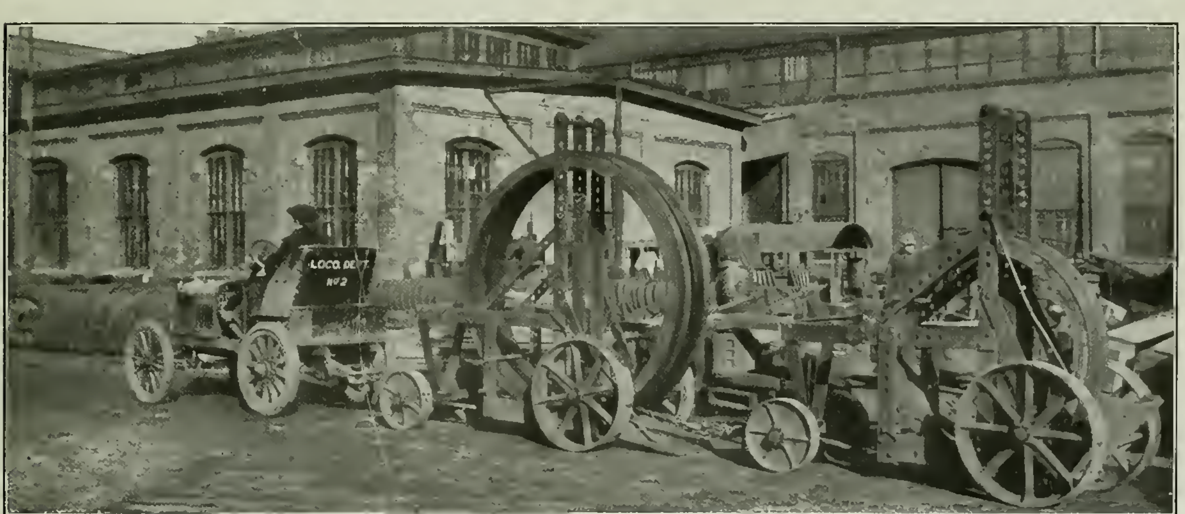


Shop Made Grinders for the Ball Joints of Superheater Units

months with excellent results. A set of superheater units can be ground with these tools in about one-third of the time ordinarily required with the regular grinders using oil and emery.

TRUCKS FOR HANDLING DRIVING WHEEL TIRES

Locomotive tires, particularly of the larger sizes, are difficult to handle unless an overhead crane or a large truck can be used. It is often necessary to transport tires from one shop to another where neither of the methods mentioned are practicable, and in such cases a considerable number of men are often used and a large amount of time consumed in the operation.



A Unique Truck for Transporting Tires

In the photograph which is reproduced above is shown a novel form of truck used in the shop of the Michigan Central at Jackson, Mich., to eliminate this waste of labor. The truck is constructed largely of second-hand material. The frame carries three uprights for holding the tires in position and the rear portion of the floor is hinged so that it can be dropped to form an incline up which the tires are run. When the tires are in place in the truck they are secured by bars placed through holes in the frame. The work of transporting a set of tires from one shop to another formerly required six hours with eight men on the work. With these trucks hauled by a remodeled Ford, the same job is handled by four men in one hour's time.

AN INSTRUCTION SCHOOL FOR ELECTRIC WELDERS

During the development of the extensive shipbuilding program of the Emergency Fleet Corporation the pressing

A Section of the School Equioment for Training Arc Welders

need for electric welders led the corporation to establish several schools for the training of electric arc weld operators. The purpose of the school was to enable men with no previous welding experience to learn the fundamentals of the art in the shortest possible time.

One of these schools was conducted under the supervision of the Lincoln Electric Company, Cleveland, Ohio. Now that the war is over this school has been released by the Emergency Fleet Corporation, and the Lincoln Electric Company is continuing it, putting its service at the disposal of any concern that desires to teach its men the art of arc welding. These men may come to the school and be instructed in any phase of the operation by thoroughly competent instructors. A general idea of the equipment employed for practical instruction work is conveyed by the photograph showing one section of the school with individual operating sets and switchboards for each operator's use.

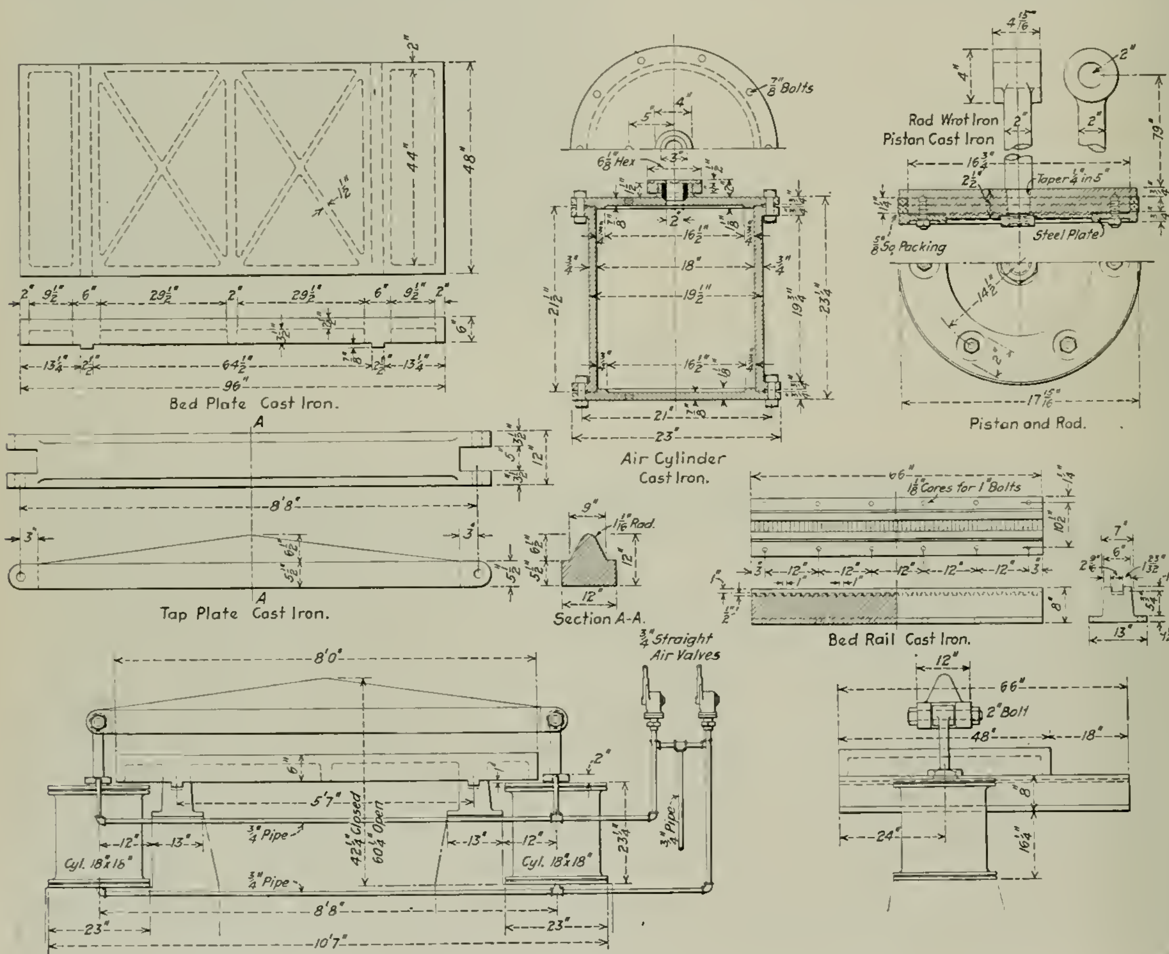
STRAIGHTENING AND FLANGING CLAMP

BY J. V. HENRY

The pneumatically operated clamp shown in the drawing is especially adapted to straightening and flanging work in connection with steel car repairs. The cast iron bed plate is 8 ft. long by 4 ft. wide, the length being sufficient to permit the straightening of the largest plates ordinarily used in steel car construction. By providing suitable blocks, larger sizes of various structural shapes may also be handled in the clamp.

The clamp is operated by two 18-in. by 18-in. air cylinders, one at either end. Two ¾-in. straight air valves are used to control the operation of the clamp, one for the admission and exhaust of air above the pistons and the other for the admission and exhaust of air below the pistons of both cylinders. The piston heads are of the solid type with a tapered fit on the rod. They are designed to take two rings of ⅝-in. square fibre packing, which are held in place by a steel follower ring.

It will be noticed that the tops of the bed rails are notched at the bottom of the grooves in which fit the tongues on the under side of the bed plate. This permits the bed plate to be moved backward or forward by means of crow bars, so that it may be used not only for straightening bent or distorted material, but also as a clamp for holding sheets in flanging operations.



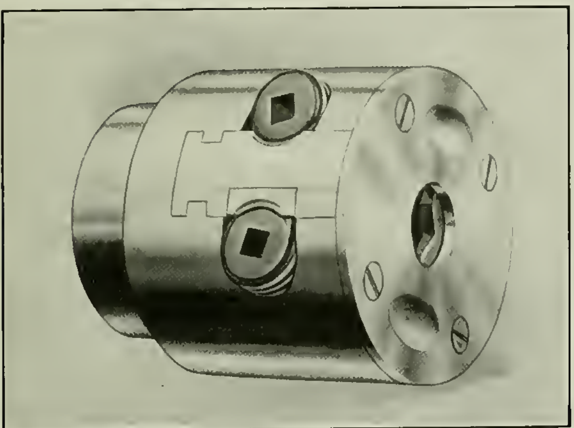
Pneumatically Operated Clamp with Movable Table, for Flanging or Straightening Steel Car Material

Stellite.—This is an alloy of semi-rare metals, but contains no iron and therefore cannot properly be termed steel. The binary alloy, consisting essentially of cobalt and chromium, can be forged with difficulty at a bright red heat, but when it becomes cool its hardness remains as great as before the first heating. According to an article in the Iron Age, by E. Haynes, Stellite does not get harder as it gets hotter, but it gets tougher and holds the cutting edge longer. Cobalt is not affected by heat up to about 1,900 deg. F., and the tungsten and chromium are not affected by any heat up to 2,600 or 2,800 deg. F. It is clear, therefore, that the cobalt becomes tougher up to the degree of softening, but at the same time the other two metals are not changed. This makes a closer and tougher bond, allays all chance of crumbling, and makes the tool last longer for the reason that it has the necessary strength to take off a heavy cut without breaking.

NEW DEVICES

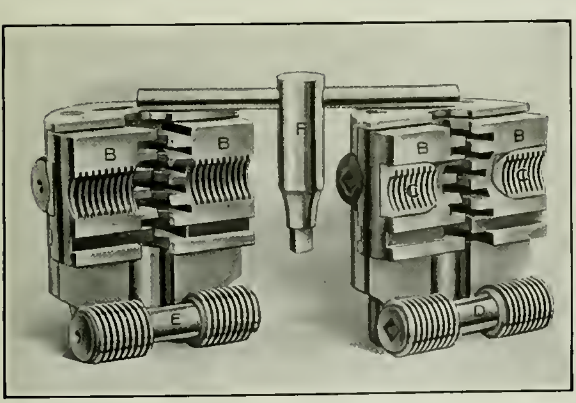
TWIN SCREW DRILL CHUCK

In the photographs are shown a twin screw drill chuck which has recently been placed on the market by the Marvin & Casler Company, Canastota, N. Y. The special features of this device are the twin screw clamping arrangement, and the rugged character of the construction throughout, the purpose being to provide for gripping the drill so firmly that it may be crowded to the limit of its strength.



The Casler Twin Screw Drill Chuck

Referring to the two views of the partially dissembled chuck it will be observed that the primary screw *E* is threaded directly in the chucking jaws *BB*, while the secondary screw *D* is threaded in floating nuts *CC*. When using the chuck the primary screw *E* is first operated to grip the drill shank between the jaws. After this screw has been set up, the secondary screw *D* is operated to bring the floating nuts *CC* against the ends of the pockets in the jaws, resulting in a grip equal to twice that obtainable by a single screw.

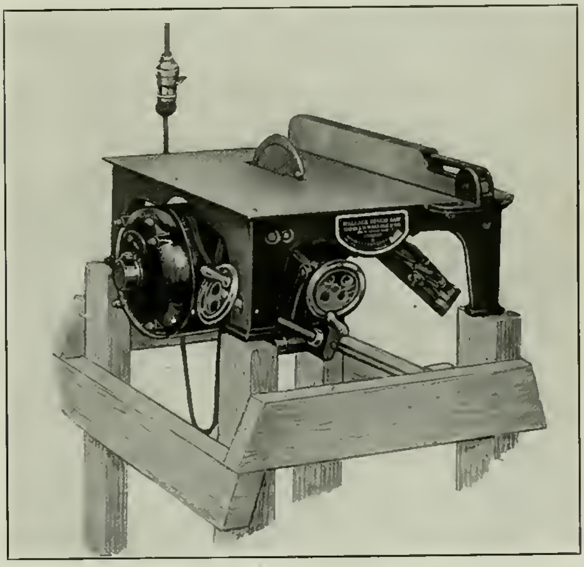


Details of the Drill Chuck

The body of the chuck is of close grained cast iron, while the jaws and screws are of high carbon steel, tempered. It is claimed that the combination of cast iron and steel tends to prolong the life of the wearing surfaces between the body, jaws and screws. The body is reinforced by a steel cap plate which prevents it from spreading when under strain, and the device has been designed to avoid any projections likely to catch the work or injure the workman.

BENCH SAW FOR WOODWORKING SHOPS

A recent addition to the line of bench machines manufactured by J. D. Wallace & Company, Chicago, is the saw shown in the illustration below. This machine is adapted for use in pattern, cabinet or carpenter shops, and is designed with a view to saving the time ordinarily wasted in taking material to a saw located at some distance from the bench. The machine can be operated on an ordinary electric light circuit, and therefore can be located at any convenient point with little difficulty. It has ample power to take a 2-in. cut through hard wood.



Bench Saw with Motor Drive

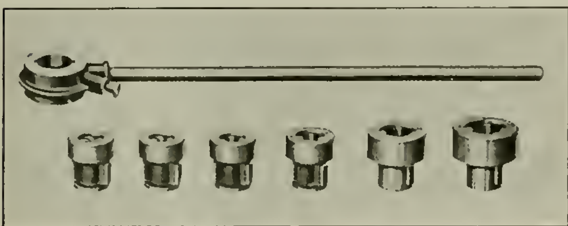
The saw has a table 17 in. by 20 in. equipped with a saw 7 in. in diameter, which can be raised and lowered and tilted to any angle up to 45 deg. The method used to adapt the saw for cutting at various angles is a departure from the usual practice. On this machine the table always remains horizontal, the motor and saw being tilted by means of a hand wheel and screw on the side of the machine. The advantage of this method over the usual tilting table is at once apparent. The saw can be raised or lowered so as to cut or groove any depth up to 2 in. The saw is driven through cut gears from a ½-hp. motor fitted with a ball bearing which also takes the thrust when the saw is tilted.

The cross-cut fence is adjustable to a 45 deg. angle. It is an integral part of the machine, but can be swung under the table when not in use. The rip fence is of the box type, and is clamped to the table by means of an eccentric lock. It is finished on both sides so that it can be used on either side of the saw. The saw is protected by a shutter guard which is held in place by a spring.

BEAVER SMALL PIPE THREADER

A pipe-threading tool has recently been brought out by the Borden Company, Warren, Ohio, for small pipe sizes. The dies are built on the unit plan to thread ⅛-in., ¼-in., ⅜-in., ½-in., ¾-in. and 1-in. pipe. The set may be secured complete or the units may be purchased seperately.

This tool, known as the No. 3 Beaver, Jr., consists of a



No. 3 Beaver, Jr., Pipe Threader

ratchet handle and separate die heads to thread each size of pipe. The whole outfit is packed in a convenient wooden case. The ratchet mechanism is entirely encased so that it is impossible for dirt or grease to accumulate and retard the action of the tool. The introduction of 1-in. size to the range adds greatly to the general usefulness of the tool.

NON-LIFTING INJECTOR INDICATOR

The usual form of tell-tale for non-lifting injectors warns the engineer by discharging a jet of steam into the cab when the injector blows back. An indicator has been developed by William Sellers & Company, Inc., Philadelphia, Pa., which not only performs the function of the tell-tale without discharge of steam into the cab, but in addition advises the engineer if the injector is wasting water at the overflow.

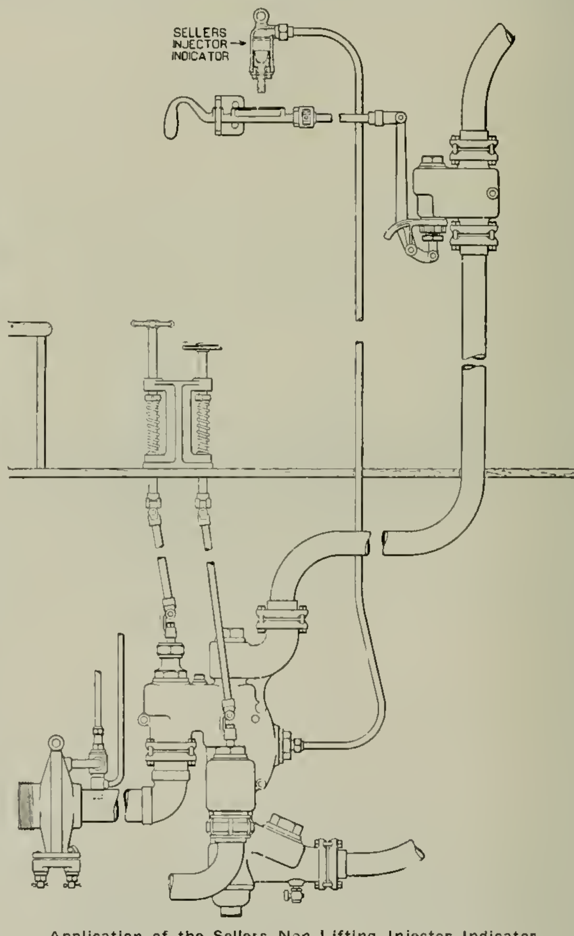
The device consists of a vertical cylinder 4 in. long, containing a loosely fitting piston, seating at each end of its stroke and provided with a projecting end, visible to the engineer when resting on its lower seat. The upper end of the cylinder is connected by a ½-in. copper wire with the overflow chamber of the injector.

Its action depends upon the well-known principle of the working of the injector, that when feeding without waste there is always a partial vacuum within the overflow chamber of an injector of the gravity overflow type. This vacuum is utilized to raise the loosely fitting piston to its upper seat, causing the projecting plug to disappear from view.

If for any cause the injector starts to waste, the vacuum within the overflow chamber is broken, the piston drops and seats at the lower end of its stroke, exposing the projecting plug. The operator is thus warned and will partially close the lazy cock, stopping the waste. If there is interruption of the water or steam supply, and the injector "flies off," the piston will instantly drop to its lower seat, preventing outflow of steam and warning the engineer of the danger.

When the injector operating valve is open, the end of the piston must always be invisible, unless heating the water in the tank. If steam is blown back into the tank in winter, the position of the projecting plug of the indicator is a continuous reminder that the injector is not operating and there may be danger of overheating the water.

A further advantage of this form of indicator is that it enables the engineer or fireman to obtain the actual minimum capacity. Most operators do not regulate the water supply closely, fearing that the injector may break off without warning or waste at the overflow. The indicator is so sensitive to conditions in the overflow chamber of the



Application of the Sellers Non-Lifting Injector Indicator

injector that the exact minimum can be obtained by regulating the lazy cock until the end of the piston appears, due to the loss of vacuum in the overflow chamber. It is claimed that a very slight opening of the lazy cock will cause the piston to rise and the exact minimum to be obtained.

The application of the indicator also will reduce the tendency of the engineer to close the heater valve, which prevents the injector from re-starting automatically. It is designed to make the non-lifting injector as safe and certain to operate as an open-overflow lifting injector.

The indicator is applicable to the Sellers, Nathan WF, Nathan Simplex, Chicago and other forms using an overflow chamber which contains the combining tube, and is closed against the atmosphere by a gravity overflow valve.

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WE GUARANTEE, that of this issue 8,390 copies were printed; that of these 8,390 copies, 7,400 were mailed to regular paid subscribers; 64 were provided for counter and news company sales, 188 were mailed to advertisers, 25 were mailed to employees and correspondents, and 713 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 31,390, an average of 7,848 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.)

The car repair shops of the Delaware & Hudson at Carbondale, Pa.—two buildings known as No. 18 and No. 20—were destroyed by fire on March 15. About 200 men are out of work temporarily. These buildings were of brick, 400 ft. long and 40 ft. wide.

In the large repair shops of the New York, New Haven & Hartford, the working time has been reduced to 40 hours a week. About 4,000 persons are affected. The Pennsylvania has reduced the working time at many shops. The Nashville, Chattanooga & St. Louis has made a reduction of 10 per cent in the forces of its large shops.

The French government, through the French High Commission, has bought from the Director General of Military Railways 485 standard gage, Pershing type locomotives now being built by the Baldwin Locomotive Works and 19,860 freight cars of various types that were under manufacture in the United States when the armistice was signed. There remains a comparatively small number of locomotives and cars yet to be disposed of and it is expected that they will be sold to some of the Allied governments.

Electric Furnace Association

At a meeting held on March 21 and 22 at Niagara Falls, N. Y., a permanent organization was formed to be known as the Electric Furnace Association, for the purpose of promoting the use of various electric furnace products. The meeting was called by Acheson Smith, vice-president and general manager of the Acheson Graphite Company, Niagara Falls. Resolutions were passed inviting all manufacturers of electric furnaces, electric apparatus, electric furnace supplies and accessories, public utility corporations, designers and inventors of electric furnace equipment and the users of electric furnaces to become members and to join in making an aggressive and thorough campaign to disseminate to engineers and the public accurate data as to the quality of electric furnace products of all kinds. The following are the officers of the association: President, Acheson Smith, Acheson Graphite Company, Niagara Falls, N. Y.; first vice-president, C. H. Booth, Booth-Hall Company, Chicago; second vice-president, W. E. Moore, Pittsburgh Electric Furnace Company, Pittsburgh, Pa.; secretary, C. G. Schluederberg, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.; treasurer, F. J. Ryan, American Metallurgical Corporation, Philadelphia, Pa.

Iron and Steel Prices Reduced

Representatives of the steel industry and the Industrial Board of the Department of Commerce at a conference in Washington during March reached an agreement on a schedule of reduced prices for the principal articles of iron and steel which will apply to all purchases by the various government departments and below which the board says the public should not expect to buy during the current year. The price schedule is of especial interest to the railroads, which are the largest purchasers of steel, and as the government is operating most of the railroads the prices will apply to purchases for railroad use. The schedule agreed upon, which is effective at once, is as follows:

				Reductions	
	November 11 price	Present price	New price	From November 11	From present
Pig iron basic	33.00 G.T.	30.00	25.75	7.25	4.25
Billets 4-inch	47.50 G.T.	43.50	38.50	9.00	5.00
Billets 2-inch	51.00 G.T.	47.00	42.00	9.00	5.00
Sheet bars	51.00 G.T.	47.00	42.00	9.00	5.00
Slabs	50.00 G.T.	46.00	41.00	9.00	5.00
Skelp sheared	3.25 cwt.	3.00	2.65	12.00 N.T.	7.00 N.T.
Skelpt universal	3.15 cwt.	2.90	2.55	12.00 N.T.	7.00 N.T.
Skelp grooved	2.90 cwt.	2.70	2.45	9.00 N.T.	5.00 N.T.
Merchant bar—base	2.90 cwt.	2.70	2.35	11.00 N.T.	7.00 N.T.
Sheared plates	3.25 cwt.	3.00	2.65	12.00 N.T.	7.00 N.T.
Structural—base	3.00 cwt.	2.80	2.45	11.00 N.T.	7.00 N.T.
Wire rod	57.00 G.T.	57.00 G.T.	52.00 G.T.	5.00 G.T.	5.00 G.T.
Plain wire	3.25 cwt.	3.25	3.00	5.00 N.T.	5.00 N.T.
Nails	3.50 cwt.	3.50	3.25	5.00 N.T.	5.00 N.T.
Black sheets, No. 28	5.00 cwt.	4.70	4.35	13.00 N.T.	7.00 N.T.
Blue annealed No. 10	4.25 cwt.	3.90	3.55	14.00 N.T.	7.00 N.T.
Galvanized sheets No. 28	6.25 cwt.	6.05	5.70	11.00 N.T.	7.00 N.T.
Tin plate No. 100 box	7.75	7.35	7.00	15.00 N.T.	7.00 N.T.
Tubular products	3½ points off card				7.00 N.T.
Hoops—base	3.50 cwt.	3.30	3.05	9.00 N.T.	5.00 N.T.
Light rails	3.00 cwt.	2.70	2.45	11.00 N.T.	5.00 N.T.
Rails standard Bessemer	55.00 G.T.	55.00 G.T.	45.00 G.T.	10.00 G.T.	10.00 G.T.
Nails standard O. H.	57.00 G.T.	57.00 G.T.	47.00 G.T.	10.00 G.T.	10.00 G.T.
Ore	No change				

Basing points and differentials unchanged. Prices effective at once.

In view of the higher costs developed throughout the world as a result of the war a return to anything like pre-war prices was regarded as out of the question.

Civil Service Examination for Locomotive Inspector

The United States Civil Service Commission announces an open competitive examination for inspector of locomotives, for men only, on May 21 and 22, 1919. Vacancies in the Interstate Commerce Commission, and in positions requiring similar qualifications, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion. The salary of the position is $3,000 per annum and necessary expenses when absent from headquarters in the discharge of official duties. Applicants must have reached their twenty-fifth but not their fifty-fifth birthday on the date of the examination, and must have not less than three years' railroad experience in the capacity of master mechanic, road foreman of engines, locomotive boiler maker, locomotive boiler inspector, roundhouse foreman, shop foreman, locomotive machinist, or locomotive engineer; or not less than five years as locomotive inspector or locomotive fireman; and must have been within three years next preceding the date of application in active service in any such capacity or in the capacity of inspector of locomotive equipment under the government of the United States or of any state or territory. Applicants should at once apply for Form 1892, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.

American Machinery in Australia

The Far Eastern Division of the Bureau of Foreign and Domestic Commerce has issued Circular No. 13 on American machinery in Australia. The report is of particular interest to readers of this paper because of the fact the railroad shops represent an important part of the market for American machine tools.

Australia, the circular says, is rapidly becoming a manufacturing country, and the demand for certain American machinery and machine tools is increasing. As a majority of the engineering establishments are also jobbing shops, the engineers in charge are averse to buying from catalogues, but desire actual demonstrations, especially of new machines, and the majority of sales are accordingly made after a sample machine has been received by the agent or importer.

The exclusive agency is accepted as the most satisfactory method of selling machinery and accessories in Australia. In a country like Australia, where vast distances must be traveled in seeking orders and where modern machinery is just being introduced, it is only fair to the agent who has stocked a machine, which may sometimes prove unsaleable, that he be protected by an exclusive contract.

Lathes are the most important essential in the machine shops which are springing up in Australia. As the majority of the work of these shops is jobbing, the machine tools should be universal. Gap lathes, for instance, permit one machine to cover a large range of work and are very popular in Australia. One American machine of this universal type has enjoyed a very large sale. Most of the American gap lathes before the introduction of this one were cheap, and light tools are not in demand.

The price of American planers as compared with that of English makes is disproportionately high. Though the American planers are very high grade with a number of automatic and convenient feeds, these conveniences have made the price too high for the Australian market, and at present there are not half a dozen of these machines in use in that country. A moderate-priced simple planer could be introduced to advantage. This is equally true of punches, shears, rolls, and other tools used in shipbuilding and structural work, our prices of which are much higher than the British.

Thirteenth Engineer (Railway) Regiment Sees Active Service

The 13th Engineers Regiment, composed of railway men on roads running west from Chicago, which has been operating military railroads back of Verdun was scheduled to leave Fleury-sur-Aire on March 7, on the way to an embarkation port preliminary to its return home. According to a cable published in the Chicago Daily News, on March 6, it has the distinction of being the first American Engineer Regiment to enter active service in the war, and has an excellent record for the handling of men and supplies, and for the assistance given in the preparation for the American drive on the Meuse-Argonne.

Although engineer regiments are generally classed as noncombatant units, the 13th has been classed as a combat unit in orders from the American and French headquarters, with the instructions that on the discharge papers of each officer and man the words, "Took part in the Champagne, St. Mihiel and Meuse-Argonne offensives," be inserted. Another distinction of the 13th is the insignia of a blue square cloth patch with a red engineer castle in the center, surrounded by a circle of 13 white stars, which indicates the beginning of the American nation and the start of the American expedition. Usually a division is the smallest unit that has its own shoulder insignia.

On October 18, 1917, the 13th took over the operation of the railroads in the French advanced zone and was relieved on February 28, 1919. At the end of 1918 it had moved 1,777 trains, carrying millions of men, including many who were wounded, and 9,230,080 tons of freight, as well as the private trains of President Poincare, General Pershing, Secretary Baker and others. The 13th was operating, on the day the armistice was signed, 229 kilometers (138 miles) of track supplying the Argonne, Verdun and St. Mihiel fronts.

As part of the railroad was within range of the German artillery and all of it within range of heavy explosives and machine guns of airplanes, the men were obliged to run the trains and repair the track under constant fire. Twenty-four immense railroad guns were firing along this line. One track was used for ammunition and the other for supplies.

Several members of this regiment received special recognition. In his letter forwarding the decorations, General Pershing said: "The cheerfulness, adaptability, loyalty and self-sacrificing devotion to duty uniformly displayed under trying circumstances by officers and men from the regimental commander to the most recently arrived private have added a new luster to the traditions of our railway service."

MEETINGS AND CONVENTIONS

International Railway Fuel Association.—The next annual convention of the International Railway Fuel Association will be held at the Hotel Sherman, Chicago, from May 19 to May 22.

American Foundrymen's Association.—The 1919 convention and exhibit of the American Foundrymen's Association will be held in Philadelphia, Pa., from September 29 to October 4. It is planned to make this convention an international one and invitations will be sent to foundrymen and industrial engineers all over the world. Details of the program will be announced later.

June Mechanical Convention Exhibits.—The Railway Supply Manufacturers' Association announces that at the assignment of space in Pittsburgh, February 14, there was sold and assigned over 80,000 sq. ft. The available space is a trifle less than 89,000 sq. ft., leaving less than 10 per cent for such exhibitors as will come in. This available space includes all of the space heretofore used in previous years together with a number of additions, which the committee found possible to use. The committee is looking over the pier with a view of providing additional space if possible, as indications are that it can be sold to exhibitors if provided. Edmund H. Walker, president of the association, in announcing the above, says that "the success of the June meeting from an exhibition standpoint is assured."

General Foremen's Association.—The annual convention of the International Railway General Foremen's Association will be held at the Hotel Sherman, Chicago, September 2, 3, 4 and 5. The topics to be discussed are as follows:

1. Welding of locomotive cylinders and other autogenous welding.

2. Safety first in shop and engine house service. The best method of application so that employees may be interested to practice same.

3. Draft gears.

The association has received permission from the Railroad Administration to hold this convention and due to the conditions on the railways at the present time a large attendance is to be desired from both the locomotive and car departments.

American Welding Society.—An association known as the American Welding Society was organized at the Engineering Societies building, New York, on March 28, 1919. This society is a merger of the welding committee of the Emergency Fleet Corporation and the National Welding Council, and its purpose is to provide a disinterested and dependable source of information on welding, not only for the benefit of the manufacturers of welding apparatus and supplies, but also to aid those who use welding in their production and those who purchase welded goods. The society will bring together in the manner usual for scientific societies persons from all branches of the industry who may be interested in any of the welding processes. It is proposed that the society will create and assist in maintaining a Bureau of Welding which will be a separate organization designed to take advantage of the principle of co-operation in research and standardization. The American Bureau of Welding will consist of a joint board of directors, 30 from the American Welding Society and one each from the various scientific and engineering societies, including the American Railway Association, and one each from the United States Commerce, Navy and War Departments and the United States Shipping Board.

Membership in the American Welding Society is divided into five classes: Class A, sustaining members, annual dues $100; open to one or more representatives from each corporation interested. Class B, annual dues $20; open to individuals who may or may not be employed by corporations, and to consulting engineers, college professors, etc. Class C, annual dues $10; open to members of existing societies which will become affiliated with the new society through the proposed Bureau of Welding. Class D, annual dues $5; open to welding artisans. Class E, open to trade associations, putting them in the same category as corporations. Class F, honorary members. Class C and D memberships do not carry the privilege of voting or holding office.

The activities of the society will include the promotion of research work on problems of common interest to all or groups of the membership, including the financing of such projects; the consideration of questions of standardization, which it is proposed shall be handled in co-operation with the American Engineering Standards Committee through the agency of the Welding Bureau; the exertion of a steadying and unifying influence on legislation affecting welding by supplying law makers with authentic information, and the study of proper methods of training autogenous welders.

It is reported that already a large number of corporations and engineers are interested in the project, including officers and members of many of the national technical and engineering societies, universities and engineering schools, government departments and bureaus, gas and electric welding companies, and shipbuilding, steel and automobile companies.

The following officers were elected:

President—C. A. Adams, President American Institute of Electrical Engineers, Cambridge, Mass.
Vice-President (for 1 year)—J. M. Moorehead, Union Carbide Company, New York.
Vice-President (for 2 years)—G. L. Brunner, Brunner Manufacturing Company, Utica, N. Y.

Directors for 1 year—
W. M. Beard, Linde Air Products Company, New York.
M. H. Roberts, Air Reduction Sales Company, New York.
M. M. Smith, Commercial Acetylene Company, New York.
L. D. Lovekin, American International Ship Building Corp., Philadelphia, Pa.
Alexander Churchward, Wilson Welder and Metals Company, New York.
W. H. Patterson, Westinghouse Electric & Mfg. Company, Pittsburgh, Pa.
Walter J. Jones, Chester Shipbuilding Company, Philadelphia, Pa.
C. A. McCune, Page Steel & Wire Company, New York.

Directors for 2 years—
R. R. Browning, Oxweld Acetylene Company, New York.
A. S. Kinsey, Professor of Experimental Mechanics, Stevens Institute, Jersey City, N. J.
Victor Mauck, John Wood Manufacturing Company, Conshohocken, Pa.
E. L. Hirt, Bethlehem Shipbuilding Corporation, South Bethlehem, Pa.
J. F. Lincoln, Lincoln Electric Company, Cleveland, Ohio.
H. M. Hobart, General Electric Company, Schenectady, N. Y.
D. C. Alexander, Quasi Arc Weldtrode Company, New York.
H. R. Swartley, Jr., Davis-Bournonville Company, Jersey City, N. J.

Directors for 3 years—
L. H. Davis, Linde Air Products Company, New York.
E. L. Mills, Air Reduction Sales Company, New York.
D. B. Rushmore, General Electric Company, Schenectady, N. Y.
James Burke, Burke Electric Company, Erie, Pa.
D. H. Wilson, Jr., Wilson Welder & Metals Company, New York.
Hermann Lemp, General Electrie Company, Erie, Pa.
C. J. Nyquist, Torchweld Company, Chicago, Ill.
Alexander Jenkins, Alexander Milburn Company, Baltimore, Md.

It was voted that the charter should be held open for ten days, and that those applying for membership in the society before April 8 should be considered charter members.

At a meeting of the directors in the afternoon, W. E. Symons, Galena Signal Oil Company, Franklin, Pa., was appointed treasurer, and H. C. Forbes, consulting engineer, New York City, was appointed secretary.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:.

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 6-8, 1919, Chicago.

American Railroad Master Tinners' Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

American Railway Master Mechanics' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, New York, N. Y.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago. Convention May 19-22, 1919, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention September 25, Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention May 26-29, Hotel Sherman, Chicago.

Master Car Builders' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 18-21, Atlantic City, N. J.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y.—Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Apr. 8	Car Trucks	W. J. Hyman	James Powell	P. O. Box 7, St. Lambert, Que.
Central	May 9	Railroad Power Plants	William Olsen	H. D. Vought	95 Liberty Street, New York.
Cincinnati	May 13	Fuel Conservation	D. E. Dick	H. Boutet	101 Carew Building, Cincinnati, O.
New England	Apr. 8	Track Maintenance		W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Apr. 18	Address by W. T. Tyler		H. D. Vought	95 Liberty Street, New York.
Pittsburgh	Apr. 24			J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	Apr. 11	Proper Loading and Handling of Live Stock.—Election of Officers	W. J. Embree	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Apr. 21			A. F. Stuebing	750 Transportation Bldg., Chicago.

Personal Mention

GENERAL

H. P. Anderson, superintendent of motive power of the Missouri, Kansas & Texas, at Parsons, Kan., has been appointed mechanical superintendent of the Missouri, Kansas & Texas and affiliated lines, with office at Denison, Tex.

M. K. Barnum, assistant to general superintendent maintenance of equipment of the Baltimore & Ohio, with office at Baltimore, Md., has been appointed mechanical engineer for the corporation.

C. J. Bodemer, division master mechanic of the Louisville & Nashville, with office at Albany, Ala., has been appointed assistant superintendent of machinery, with headquarters at Louisville, Ky., succeeding Millard F. Cox, resigned to engage in other business.

E. W. Pratt, assistant superintendent of the motive power and car departments of the Chicago & North Western, with headquarters at Chicago, retired from active service on March 1, and was granted an extended leave of absence. Although only 50 years of age, Mr. Pratt has served the Chicago & North Western for nearly 30 years, starting as a message boy and telegraph student when 14 years old, then working in the engineering department and on construction work to earn money to enable him to complete a course of mechanical engineering at Lehigh University, where he also specialized in chemistry and metallurgy. Having had practical work in both civil and mechanical engineering, Mr. Pratt specialized in electrical engineering for one year with the Western Electric Company of Chicago, and again entered the employ of the Chicago & North Western as general air brake inspector and instructor, being promoted successively to enginehouse foreman, general foreman, master mechanic and assistant superintendent of the motive power and car departments, in which latter capacity he has remained ten years. Mr. Pratt has been active in railway association work, having been president of the Western Railway Club, Chicago, in 1914-15; president of the American Railway Master Mechanics' Association in 1915-16 and president of the International Railway Fuel Association in 1917-18.

E. W. Pratt

R. W. Burnett, superintendent motive power of the Missouri, Kansas & Texas of Texas at Denison, Texas, has been appointed assistant mechanical superintendent of the Missouri, Kansas & Texas and affiliated roads, with office at Denison.

E. B. Hall, assistant superintendent of the Wisconsin division of the Chicago & North Western, with headquarters at Milwaukee, has been appointed assistant superintendent of the motive power and car departments of the road, with headquarters at Chicago, to succeed E. W. Pratt, who is on leave of absence.

W. H. Maddocks has been appointed mechanical engineer of the Missouri, Kansas & Texas and affiliated roads, with office at Parsons, Kan.

T. O. Sechrist, general master mechanic of the Louisville & Nashville, with office at Louisville, Ky., has been appointed assistant superintendent of machinery and the position of general master mechanic has been abolished.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

G. H. Berry has been appointed master mechanic of the Knoxville and Atlanta divisions of the Louisville & Nashville, with headquarters at Etowah, Tenn., succeeding W. E. Hunter.

Clyde L. Bunch, whose appointment as master mechanic of the Southern Railway, with headquarters at Sheffield, Ala., was announced in these columns last month, was born in Wake county, N. C., on February 14, 1878, and received a high school education. In the summer of 1902 he entered the employ of the Richmond, Fredericksburg & Potomac as a machinist at Richmond, Va., resigning in the summer of 1904 to accept a similar position with the Chesapeake & Ohio. On March 1, 1905, he went to the Southern Railway as a machinist in the Spencer, N. C., shops, was promoted to gang foreman there in April, 1909, erecting shop foreman on October 1, 1909, and since January 1, 1913, until he was appointed master mechanic, acted as shop superintendent at Spencer.

C. L. Bunch

W. E. Hunter, master mechanic of the Knoxville and Atlanta divisions of the Louisville & Nashville, at Etowah, Tenn., has been transferred to the Cincinnati Terminals and Kentucky division, with office at Covington, Ky., succeeding C. W. Mathews.

C. W. Mathews, master mechanic of the Cincinnati Terminals and Kentucky division of the Louisville & Nashville, with office at Covington, Ky., has been transferred to the Albany (Ala.) shops, succeeding C. J. Bodemer, assigned to other duties.

CAR DEPARTMENT

Richard W. Moore, general car foreman on the Canadian National at Cochrane, Ont., has been promoted to district car foreman, with headquarters at Saskatoon, Sask. He was born at Listowel, Ont., on October 20, 1882, and received his education in the Brandon high school of that place. He entered railway service in July, 1906, as a car repairer on the Grand Trunk Pacific, which position he held for two years when he was promoted to car foreman, serving in that capacity for nine years at Melville, Sask., Rivers, Man., and Fort William, Ont. When the National Transcontinental was taken over by the Canadian government, Mr. Moore was transferred to that road as car foreman. In November, 1917, he was appointed general car foreman, with headquarters at Cochrane, Ont., which position he held until his recent appointment as district car foreman of the Canadian National, with headquarters at Saskatoon.

PURCHASING AND STOREKEEPING

J. M. Velasco, local purchasing agent of the National Railways of Mexico, at New York, has been appointed assistant to the general purchasing agent, with office at Mexico City, Mex., and F. P. de Hoyos, general agent of the traffic department, at New York, is now also local purchasing agent, with office at New York.

A. E. Cox, whose appointment as general steorkeeper of the Canadian National, Western Lines, with headquarters at Winnipeg, Man., was announced in the *Railway Mechanical Engineer* last month, was born at Huddersfield, Eng., in 1863, and received his education in private schools at Hamburg, Germany, and college at Huddersfield. Mr. Cox first entered railway service in 1883 as timekeeper on the Canadian Pacific Western division, with headquarters at Moose Jaw, Sask., which position he held for four years, when he was appointed chief clerk in the stores department of the Manitoba & Northwestern. In 1893 he was appointed storekeeper when the Manitoba & Northwestern was absorbed by the Canadian Pacific, and the following two years was assistant to the superintendent of construction of the Ontario and Rainy River section of the Canadian Northern. Since 1912 he was storekeeper of that road, until his recent appointment on the Canadian National.

A. E. Cox

George W. Snyder has been appointed general storekeeper of the Pennsylvania Railroad, eastern lines, with headquarters at Philadelphia, Pa. Mr. Snyder was born at Pottsville, Pa., on January 9, 1866, and was educated in the public schools of Pottsville and at Lehigh University. Mr. Snyder began railway work with the Pennsylvania Railroad on November 1, 1884, as rodman on the Renovo division. He was appointed assistant supervisor of the same division on January 1, 1886, and in August. 1890, was promoted to supervisor. On June 10, 1897, he was appointed supervisor on the Northern Central at Baltimore, and three years later was transferred to the Altoona yard. He was promoted to division engineer of the Monongahela division in January, 1901, and in June, 1903, was transferred to the Pittsburgh division. On April 1, 1907, he was appointed principal assistant engineer of the Western Pennsylvania division; in October, 1917, he was made assistant engineer, maintenance of way, in charge of bridges and structures, and served in that position until his recent appointment as general storekeeper.

G. W. Snyder

Supply Trade Notes

J. J. Haigh has been appointed assistant district manager of sales for the Chicago Pneumatic Tool Company, with headquarters at 175 First street, San Francisco, Cal.

Nelson B. Gadch has been appointed district manager of sales for the Chicago Pneumatic Tool Company, with headquarters in the Metropolitan Bank building, Minneapolis, Minn.

The A Gilbert & Sons Brass Foundry Company, St. Louis, Mo., recently installed a complete chemical laboratory at its plant and all products are now made under chemical supervision.

Fred H. Waldron, Minneapolis representative of the Chicago Pneumatic Tool Company, has been appointed manager of the pneumatic tool sales division, to succeed J. D. Osgood, who has resigned.

The Dearborn Chemical Company, Chicago, announces the opening of offices in the Commerce Trust building, Kansas City, Mo. E. M. Massen and W. H. Fairlamb will make their headquarters at that office.

John W. Foyle, vice-president of the Gustin-Bacon Manufacturing Company, Kansas City, Mo., who has been a major in the United States Army, has been released from service and has returned to his duties with his company.

Frank G. Wallace, vice-president of the Canadian Locomotive Company, has been elected president to succeed the late Dr. J. J. Harty, who died in London on February 23. J. L. Whiting succeeds Mr. Wallace as vice-president.

Clyde P. Benning, service manager of Mudge & Company, Chicago, has been appointed assistant general manager with headquarters at Chicago, in which position he will assist the railroad companies in developing motor car organizations.

J. E. Slimp, who has for many years been connected with the sales department of the Ohio Brass Company, Mansfield, Ohio, has resigned to become associated with H. C. Dodge, of Boston, who is at the head of several manufacturing companies in New England.

J. I. Edwards has been appointed manager of the rock drill sales division of the Chicago Pneumatic Tool Company, succeeding K. Eklund, who has been appointed special foreign representative, and who will leave shortly for Europe in the interest of that company.

J. A. Farris, who has been connected with the Whiting Foundry Equipment Company, at Chicago, as crane engineer in the engineering department for the past 10 years, has entered the employ of Scully-Jones & Co., at Chicago, as special sales engineer on cranes.

The controlling interest of the Carroll Foundry & Machine Company, Bucyrus, Ohio, manufacturers of locomotive cranes, has been purchased by Cleveland interests, and a temporary organization has been perfected which will be taken over later when the company is reorganized.

C. E. Hague, formerly production engineer of the Mid-West Engine Company, Indianapolis, Ind., has been appointed sales manager of the American Steam Conveyor Corporation, Chicago, manufacturers of the American steam ash conveyor and other ash handling equipment.

Lieutenant Sherman C. Amsden, formerly connected with Mudge & Co., Chicago, has been appointed assistant to the president, in which position he will have charge of publicity, special sales plans, and investigations. Upon his honorable release from the service he returned to Mudge & Co. to become assistant to the president.

The Chicago Pneumatic Tool Company announces the removal of its Boston, Mass., office to 182 High street. F. F. Eggleston, district manager of sales, will represent the company in that territory. The company also announces the opening of offices and warehouses at Tulsa, Okla.

Malcolm L. Maclean, formerly manager of sales, miscellaneous department, of the American Steel Foundries, with headquarters at Chicago, and until recently a major in the infantry, has been appointed manager of sales of the Duquesne Steel Foundry Company, at Pittsburgh, Pa.

Jean K. Vanatta, mechanical engineer of Mudge & Company at Chicago, has been appointed service manager, in which capacity he will have charge of the company's service engineers, who are working with the motor car men on the various railroads throughout the country, as well as the developing of the service idea.

The Bridgeford Machine Tool Works and the Betts Machine Company of Rochester, N. Y., announce the opening of joint branch offices in New York and Chicago. The New York office is located at 50 Church street, in charge of F. C. Severin, and the Chicago office is at 549 Washington boulevard, in charge of A. W. Van Buren.

General Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, was recently decorated with the United States government distinguished war service medal, which was awarded him for his work in systematizing methods and practices in industries producing ordnance material for the army.

A. N. Willsie has resigned from the Chicago, Burlington & Quincy, with which company he has been connected for the past 29 years, to accept the position of district engineer of the Locomotive Stoker Company, with headquarters at Chicago. Mr. Willsie was born in Galesburg, Ill., where he received his primary school education. He entered the service of the Burlington on April 20, 1880, as an errand boy in the master mechanic's office, and later filled the position of chief clerk to the master mechanic in the same office. In 1890 he became a locomotive fireman, and then was engineman for six years when he became road foreman of engines, from which position he was promoted to division master mechanic at Brookfield, Mo., Aurora, Ill., and Omaha, Neb. Mr. Willsie left the mechanical department to take the position of division superintendent in the operating department, and for two years filled this position at St. Joseph, Mo., and three years at Hannibal, Mo. Since June, 1912, Mr. Willsie has been permanent chairman of the fuel economy committee and superintendent of fuel economy of the Burlington, with headquarters in Chicago, reporting direct to the general superintendent of motive power, and vice-president in charge of operation.

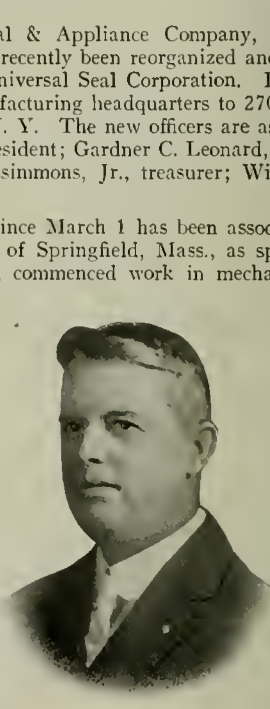
A. N. Willsie

Edwin Besuden has been appointed eastern district manager of the railway department of the Chicago Varnish Compeny, in charge of steam and electric railway sales. His headquarters are at 50 Church street, New York. Mr. Besuden was formerly sales manager of the Jewett Car Company and was connected with that company for 16 years.

The Pollak Steel Company announces that the G. F. Cotter Supply Company, Houston, Texas, will represent it as Southwestern sales representative. They will endeavor to sell the products, consisting of forgings of all kinds, axles, locomotive parts, as well as the Pollak special heat treated products. This covers the material produced both at the Cincinnati as well as the Chicago works.

The Universal Car Seal & Appliance Company, Lyon Block, Albany, N. Y., has recently been reorganized and has changed its name to the Universal Seal Corporation. It has moved its offices and manufacturing headquarters to 270-276 Hudson avenue, Albany, N. Y. The new officers are as follows: C. R. Martineau, president; Gardner C. Leonard, vice-president; Edward J. Fitzsimmons, Jr., treasurer; William C. Martineau, secretary.

John B. Canfield, who since March 1 has been associated with the Harley Company of Springfield, Mass., as special representative and counsel, commenced work in mechanical lines with the Boston & Albany, at Boston, Mass., in 1885, as machinist apprentice. He continued with the railroad as foreman machine shop, general foreman locomotive department and master mechanic of the Albany and Boston divisions, severing his connection with railroad work in 1916, after a continuous service of 30 years. In 1906, while in the railroad service as master mechanic at Boston, Mass., Mr. Canfield enrolled as a law student in the Boston Evening Institute, now the Northeastern College of Law, graduating in June, 1910, with the degree of LL.B., and was admitted to the Massachusetts bar September 23, 1910. At the time of his coming to the Harley Company, he was actively engaged in the practice of his profession at Springfield, Mass. During the war he served as major of engineers, and was commanding officer of the Sixth Battalion, 21st Engineers, being honorably discharged in January of this year.



J. B. Canfield

Arthur F. Braid has been appointed sales manager of the metal and alloy department of the Metal & Thermit Corporation, New York. Mr. Braid went to the company seven years ago as a traveling salesman, and after a few years of service in this capacity was appointed assistant superintendent of the Jersey City plant, in charge of the manufacture of carbonfree metals and alloys. When the United States entered the war, he assumed active charge of metal sales at the New York office of the company.

C. W. Johnson has been appointed assistant manager of works of the Westinghouse Electric & Manufacturing Company. After graduating from Ohio State University, Mr. Johnson entered the employ of the Steel Motor Company of Johnstown, Pa. A year later he became associated with the Bullock Electric Company, of Cincinnati, Ohio, and in 1904 was made superintendent of Allis-Chalmers-Bullock, Ltd., of Montreal, Can. In 1907 he entered the employ of the Westinghouse company, being appointed chief inspector of works, in which capacity he served until his recent appointment.

George K. Heyer is the new assistant telephone sales manager of the Western Electric Company, having been advanced from the position of railway sales engineer. He has been an employee of the company since 1902, and always has been in New York. He will remain there as his headquarters will be at 195 Broadway. E. V. Adams succeeds G. K. Heyer as railway sales engineer. He has been a Western Electric man since 1910, when he began in the railway sales department of the Chicago house. He was transferred to St. Louis in 1912, and the following year went to New York, where his headquarters will remain.

P. Harvey Middleton, executive assistant of the Railway Business Association, was invited by Señor M. Muñoz, general superintendent of the Mexican National Railway Administration, during his visit to New York recently, to make a trip with him over all the lines under the control of the Carranza government. Mr. Middleton has accepted the invitation and will leave for Mexico shortly. He will be met at Laredo, Texas, by Señor Muñoz and will visit all points of interest, including the steel mills and railway machine shops. Mr. Middleton speaks Spanish, which will aid him greatly in his investigations.

Wilson W. Butler, whose appointment as president of the Canadian Car & Foundry Company, Ltd., the Canadian Steel Foundries, Ltd., and the Pratt & Letchworth Company, Ltd., Canada, was announced in the *Railway Mechanical Engineer* last month, was born at Danville, Ohio, on December 9, 1862, and received his early education in the Danville Select School. Mr. Butler began his business career with the John Shillito Company, at Cincinnati, Ohio, and later was appointed western manager of the Sterlingworth Railroad Supply Company, at Chicago. Subsequent to his appointment as president of the Canadian Car & Foundry Company, Mr. Butler served as western sales agent of the American Car & Foundry Company, at Chicago; second vice-president and director of the Simplex Railway Appliance Company, at New York, and second vice-president and director of the American Steel Foundries, at New York. In 1901, as vice-president and director of the Simplex Railway Appliance Company, he established the manufacturing plant of that company in Montreal, Que. He was also vice-president and director of the Dominion Steel Car Company, near Montreal, where the first steel car manufactured in Canada was built. Mr. Butler was instrumental in the organization of the Canadian Car & Foundry Company, Ltd., composed of the Dominion Car & Foundry Company, the Canada Car Company and the Rhodes Curry Company. Since shortly after the beginning of the war, the plants of the companies of which Mr. Butler is president have been engaged in the production of steel, and the forging and machining of shells, for the American, British and Russian governments. Mr. Butler succeeds Senator N. Curry, who has retired from the presidency of the companies, and now holds the position of chairman of the board of directors.

W. W. Butler

Samuel T. Fulton, vice-president of the Railway Steel Spring Company, died in New York on March 29, at the age of 52 years. He was born in Topeka, Kan., and spent many years in railroad service in the west, becoming assistant to the president of the Chicago, Rock Island & Pacific in 1904. In 1909 he became associated with the spring corporation.

Lieut.-Colonel Merril G. Baker has been elected president of the American International Steel Corporation, effective April 1. Colonel Baker was formerly assistant manager of sales of the Cambria Steel Company and has been for many years one of J. Leonard Replogle's right hand men. He succeeds the late Edward M. Hagar, who died over a year ago. The American International Steel Corporation is the steel exporting subsidiary of the American International Corporation.

At the annual meeting of the stockholders of the Westinghouse Air Brake Company, held March 31 at the general office of the company in Wilmerding, Pa., A. L. Humphrey, who has been vice-president and general manager of the company since 1909, was elected president, succeeding John F. Miller. This action was taken at the solicitation of Mr. Miller, who after a service of 30 years, during which period he rose from the position of real estate agent for the company to its highest executive office, is desirous of being relieved of some of the active duties in the management of the air brake interests. He will remain, however, a member of the board of directors and hold the position of vice-chairman of the board, with H. H. Westinghouse as chairman.

The Onondaga Steel Company, Inc., Syracuse, N. Y., announces the addition to its board of directors of Morton D. Whitford, treasurer of the Semet-Solvay Company, and Charles H. Canfield, general auditor of the Onondaga Steel Company. The company is planning to remove its offices and remaining furnace and melting equipment this spring from its original plant in Syracuse to a large tract of land it recently acquired at Eastwood on the outskirts of Syracuse, and plans have been made for the immediate construction of a large temporary office building and an addition to the main building, 40 ft. by 40 ft., which will house the blacksmith shop and the small hammer shop.

W. J. Austin, general manager of The Austin Company, industrial engineers and builders, Cleveland, Ohio, has just returned from a three-months' trip to France, Belgium and England. Mr. Austin, in company with J. K. Gannett, export sales manager of the Austin Company, sailed from New York City on December 5. The party which included Alvin T. Fuller, member of Congress from New England, were for a time the guests of the British government and were taken on a thousand-mile trip over the battlefields. The 13 buildings which were erected by the American forces for the U. S. Army Transport Service, under the Austin Company's supervision, were inspected by the party. The first building was erected at St. Nazaire by the 17th Engineers in December, 1917, and the remaining buildings were erected at Verneuil.

H. A. Jackson, president of the Chicago Pneumatic Tool Company, Chicago, returned February 19 from England, where he has been inspecting the foreign plants of the corporation. The Consolidated Pneumatic Tool Company, Ltd., and the Pneumatic Tool Company (respectively the selling agency and the manufacturing corporation), subsidiaries of the Chicago Pneumatic Tool Company in England, were found to be in excellent condition. During the war the company made some profit manufacturing bayonets for the British government while carrying on its regular tool business to capacity. News of the disposition of the International Compressed Air & Electric Company of Berlin, Germany, which the Chicago Pneumatic Tool Company owns, has not yet been received, although Mr. Jackson has been striving for a year to get word of this property.

Catalogues

Time Zones.—A large calendar and wall map of the United States and the greater part of Canada, 28 in. by 40 in., is being issued by the Metal & Thermit Corporation, New York, the map showing the new railroad time zones in the United States, which went into effect on January 1, 1919.

Welding.—Two small folders have been issued by the Air Reduction Sales Company, New York, showing benefits derived from the use of their products and methods, one illustrating the results of repairing a badly damaged locomotive cylinder by Airco methods, and the other showing the Airco process of building up worn frogs.

Roller Bearings.—The distinctive features, together with price lists for the different sizes of its type "C" roller bearings, which are recommended for use under conditions of medium loads at medium speeds, such as inspection cars, baggage trucks, etc., are set forth in bulletin No. 1004, issued by the American Roller Bearing Company, Pittsburgh, Pa.

Overhead Carrying Systems.—Catalogue 50, issued by the Coburn Trolley Track Manufacturing Company, Holyoke, Mass., manufacturers of overhead carrying systems for both "round trough" and I-beam, shows price lists, illustrations, plans and dimension drawings of overhead carriers and their details. The catalogue contains 56 pages, 8½ in. by 11 in. and illustrates a number of actual installations.

Pipe Threading Machinery.—An illustrated catalogue of pipe threading and cutting machines and pipe and nipple threading machines has been issued by the Landis Machine Company, Inc., Waynesboro, Pa. The catalogue contains a detailed discussion of all the machines, but aims principally to set forth the distinctive features of the Landis die and chaser as compared with other types. This is known as catalogue No. 25 and copies may be had upon request.

Twist Drills, Reamers, Etc.—A machinists' supply catalogue, No. 91, listing carbon and high speed twist drills and reamers, screw and drop forged wrenches, spring cotters and keys, etc., has been issued by the Whitman & Barnes Manufacturing Company, Akron, Ohio. The catalogue contains 183 pages and a distinctive feature of it is a thumb index marked to show the products listed in the various sections, making it an easy matter to find desired information.

Pumping Machinery.—The National Transit Company, Oil City, Pa., manufacturers of special machinery to meet the requirements of pipe line companies, have begun the manufacture of other machinery for general service, including pumping machinery, gas and oil engines, which together with old lines are illustrated and described in various bulletins. These have been bound in heavy manila covers in such a way that others may be added from time to time as they are issued.

Drills and Reamers.—The Clark Equipment Company, Buchanan, Mich., lists and briefly describes all of the standard tools comprising the Celfor line in catalogue No. 16. These include drilling and reaming tools of various kinds, drill chucks, drill sockets, lathe tool holders, tool bits, flue cutters and drill gages. In the back of the book are several pages of tables showing feeds and speeds for Celfor drills and decimal equivalents in inches of millimeters and fractions of an inch.

Slotting Machines.—Latest information on three types of Newton slotting machines in a variety of sizes is given by the Newton Machine Tool Works, Inc., Philadelphia, Pa., in catalogue 49-A. This catalogue also contains photographs and brief specifications of upright generating planers, cold saw cutting off machines, locomotive link grinding machines, horizontal milling machines, vertical milling machines, rotary planers, keyseat milling machines and duplex locomotive rod boring machines.

Shop Production.—"The Missing Link" is the title of a 16-page booklet issued by the Gisholt Machine Company, Madison, Wis., explaining the principle of the Periodograph and the advantages to be secured from its installation. This machine was developed to make it possible to secure an accurate record of the time actually spent in producing, and the time lost by workmen waiting for materials, broken machines, lack of power, and other causes of delay. The booklet shows several cards which are used for registering the time lost, with the reasons, and a chart showing the record of a machine for an entire year.

Baldwin Locomotives.—In September, 1918, the Baldwin Locomotive Company completed the erection of its fifty-thousandth locomotive, which is the subject of Record No. 91. This locomotive is one of a group of 12 built for the Southern Railway Company and is of the Mallet articulated type with 2-8-8-2 wheel arrangement. The booklet gives some interesting facts regarding the Southern Railway System and a brief review and several illustrations of motive power built by the Baldwin Locomotive Works for this road, in addition to a description of the 12 Mallet locomotives represented by locomotive No. 50,000. It also contains interesting information regarding the growth of the locomotive industry and of the Baldwin Locomotive Company's plants, illustrations showing the shop in which the first Baldwin locomotives were constructed and the various plants in operation at the present time.

Perforated Metals.—The Hendrick Manufacturing Company, Carbondale, Pa., manufacturers of perforated metals, etc., has issued a catalogue of 127 pages which will be found useful for reference purposes to the user of perforated metals. Thirty-six pages are devoted to reproductions of standard perforated screen plates and 25 pages to illustrations of manufactured screens for various purposes in handling coal, cement, ore, etc., including strainers for locomotives and metal spark arresters for locomotive front ends. This company also manufactures elevator buckets, conveyor troughs and flights, stacks, tanks, hoppers, etc., which are also listed in this catalogue. Of special value should be found the tables showing the styles and sizes of perforations and the spaces between holes and maximum widths and gages in steel, according to the United States standard gage, and a number of tables of weights, measures, and gages for coal screens, decimal equivalents, metric conversion tables, etc.

Car Heating Devices.—The Gold Car Heating & Lighting Company, New York, has issued circulars describing the construction and operation of car heating apparatus which the company has recently developed. These are a vapor valve, No. 1112, designed for application on the inside of the car; packless end valve No. 1126, with automatic drip in the valve itself; packless quick opening single and twin supply valves, Nos. 1140 and 1145, respectively, which open and close on a quarter turn; and pop valve No. 1137, a train line safety valve designed to prevent the blowing off of the steam hose in case of excess pressure and also successfully used as a safety valve for hot water circulating systems. Circulars have also been issued describing other Gold devices, including a combination gasket tool No. 1077, for use in applying and removing coupler gaskets; a pressure regulator with a large steam capacity for long passenger trains, No. 1014; steam hose coupler, No. 804-S, with oscillating gasket; and steam hose coupler gasket G-4, for use in steam hose couplers using non-oscillating gaskets.

Railway Mechanical Engineer

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CONTENTS

OUR CINCINNATI OFFICE

The Simmons-Boardman Publishing Company, publisher of the *Railway Mechanical Engineer,* has opened an office in the First National Bank Building, Cincinnati, Ohio. It will be in charge of R. H. Smith, a member of the business staff formerly connected with our Chicago office, who will look after the interests of the Simmons-Boardman publications, including the *Railway Mechanical Engineer,* Railway Age, Railway Maintenance Engineer, Railway Signal Engineer, Railway Electrical Engineer and the Locomotive and Car Builders' Dictionaries.

Tender Tanks Need Stronger Bracing

One of the common results of collision is to cause the tender tank to slide forward off the underframe, demolishing the cab and in some cases injuring the enginemen. While such accidents are not of frequent occurrence, it is important that every precaution should be taken to prevent personal injuries in such circumstances and for that reason it would seem advisable to fasten tender tanks to the frame in a manner that would prevent the shifting of the tank, at least in so far as it can be avoided in minor collisions. The types of fastenings generally used on rectangular tanks have evidently not been designed with that end in view, but are intended rather to withstand only the pressure occasioned by the shifting of water resulting from brake applications. The weight of the contents of a large tender when fully loaded is more than 100,000 lb. yet this great mass is often secured to the underframe by six or eight bolts ⅞-in. in diameter. This criticism of the fastenings used on tenders does not apply with equal force to cylindrical tanks as they are usually set between headblocks which effectually prevent any shifting. On tenders with rectangular tanks, however, increased safety could no doubt be secured by the use of heavier braces to secure the tanks to the underframe or by forming a depression in the underframe into which the tank could be set.

Railroad Y. M. C. A. Extension

The Railroad Y. M. C. A. is about to enter a national extension movement that promises to double or triple its effectiveness within the next year. There are now about 300 Railroad Y. M. C. A.'s in this country and Canada. The greater part of their energies has been devoted to looking after the physical needs of the trainmen; and the practical results, in the way of increased safety and more efficient operation, are recognized by hard-headed railroad officers throughout the country. Some of the associations have given considerable attention to the needs of shopmen also, and not a few of them have been developed into community centers. The Railroad Y. M. C. A. believes, however, that it has a duty to perform for every individual on the railroads, although they may not be able to use the buildings in the same way as do the men in the train service. There is a big field, for instance, for educational work among certain classes of employees. There is real need in many places for an Americanization program. Many believe that the Railroad Y. M. C. A., with its physical experts, can be a strong factor in helping to develop system athletics and also to carry on a more extended program looking toward the physical needs of the individuals. There are many other phases of the work that might be extended to advantage.

The present extension movement includes a membership campaign this month and a series of campaigns during the fall in order thoroughly to organize the work in all departments for the next year. The extension movement is being very carefully planned, and one interesting development is that the railroad men, themselves, are taking the most aggressive part in promoting it; the secretarial staff is being used largely in an advisory capacity. The importance of this development in the success of the movement can be readily recognized by those who have given critical attention to the various aspects of the industrial problem, particularly so far as they relate to the so-called welfare work or the matter of relations between employers and employees.

Inspection and Test Sectioo Draft Gear Tests

At the invitation of the Inspection and Test Section of the Railroad Administration about 60 representatives of draft gear manufacturers, railroad men and others interested in the draft gear subject, witnessed a series of unofficial demonstrations at the draft gear testing plant of the T. H. Symington Company, Rochester, N. Y., in which was set forth a unique method of recording the action of draft gears under impact between two cars. The purpose of the demonstrations was to give all those interested an opportunity to study the recording apparatus and the methods used in advance of the official tests to be conducted by the Test Section on practically all the well-known types of draft gears. Aside from the unique method of graphically recording the action of the gears under impact, a description of which appears elsewhere in this issue, the outstanding feature of the demonstrations was the spirit of fairness and frankness with which constructive criticism and suggestions were requested and received by those in charge of the tests.

The series of tests under approximately service conditions, which are to follow the public demonstrations, are a part of a program in which complete comparative studies of the various draft gears are to be made. The work so far outlined is dealing with new gears. This, however, is but one phase of the whole draft gear problem. What is required in service is not only a gear possessing the nearest approach to ideal characteristics, but one which maintains throughout a reasonable service life the nearest approach to ideal characteristics. An investigation of this phase of the subject is one requiring a large amount of time and effort over a period of years. The draft gear committee of the Master Car Builders' Association, which is co-operating with the Inspection and Test Section, has been and is investigating this phase of the subject, and it seems reasonable to expect as the result of the efforts of the two co-operating agencies that results of great value eventually will be obtained.

The Mechanical Conventions

The Master Car Builders' Association and the American Railway Master Mechanics' Association will this year meet as the Mechanical Section of the American Railroad Association. The convention, which is to be held at Atlantic City the latter part of June, promises to be the largest and most successful one ever held. The reports will be out early so that the members can digest them before going to the meetings. The Railroad Administration is lending its full aid and support in order to have a representative attendance. The exhibit space, although it has been greatly increased over that required in the record-breaking year, 1913, promises to be inadequate.

The mechanical department officers and foremen should, of course, plan to take full advantage of this convention which has been discontinued since 1916 because of the war. On the other hand, they must recognize that they are on trial and that they will be closely watched not only by the Railroad Administration, but by the higher executive officers. They have a real opportunity to put the mechanical association on a much higher plane than was ever thought of in the past because it will now be possible to pass on its recommendations to the American Railroad Association and to have them made effective, if approved, by the Railroad Administration. Will the mechanical department officers grasp this opportunity and make full use of it?

Various suggestions have been made as to how each road may get the most from meetings of this sort. One of the best is that every man who is sent to the conventions be asked to report in writing those things that came to his attention that he thinks can be applied to good advantage on his own road. It may be that the suggestions will spring from some report presented to the convention or from the open discussion of it. It may be that the exhibits will suggest something or possibly the informal discussions, at the table, in the hotel, or on the train with officers of other roads, or with railway supply experts. If several men are sent from one road, it would seem wise to have each one instructed to investigate those problems which he is best fitted by experience and training to study. Is it not about time for the railroads to make scientific use of meetings of this kind and definitely to plan to get the utmost return from them?

Modernizing Stationary Power Plants

The intensive fuel conservation campaign that has been carried on during the past two years has caused the railroads to give more attention to the condition of stationary power plants. The result has been a remarkable increase in the efficiency of such plants, which many roads had formerly neglected. These economies were effected under the stress of war conditions, but the officers of the railroads should take effective measures to insure the continuance of the splendid performance now being secured. One of the reasons that the condition of stationary power plants was neglected in the past was that the roads had no special organization to supervise their operation but left it in the hands of the general foremen who were primarily shop executives and could hardly be expected to be authorities on the economical operation of power plants. It is evident that an organization charged with the responsibility for maintaining the condition of power plants at a high standard is needed to secure the best results and such a staff should be organized on every road, if it has not already been formed.

The mere fact that a power plant is operating at higher efficiency than ever before does not prove that the plant itself is efficient. During the war it was necessary to keep uneconomical equipment in service because new engines and boilers could not be secured. That difficulty has now been removed and it is advisable at this time to investigate the possibilities of saving by the redesign of existing installations. The question should be considered in the light of present conditions as conclusions based on data secured when lower wages and prices prevailed are sure to be misleading. Far larger expenditures to effect a given saving are justified now because of the great increase in the cost of fuel. There are many railroad power plants operating today with old boilers, perhaps taken from obsolete locomotives, and uneconomical reciprocating engines. In such cases it would almost invaribly prove advisable to install modern boilers and turbines. Aside from the reduction in fuel cost, there is often an opportunity for further saving by a reduction in the number of attendants required at the power house. This is especially true where large shops are supplied with power from several small plants. Such installations though not uncommon represent the extreme in the inefficient utilization of both fuel and labor and should be replaced as rapidly as possible.

Fuel Cooservation and the Movies

Moving pictures are not new in connection with educational work on the railroads. Possibly their most notable application in that field is in connection with the safety-first movement. The Pennsylvania Railroad has, however, gone outside of that field and has prepared some excellent films in connection with the maintenance of equipment, locomotive operation, etc. Moving pictures taken by the Northern Pacific in connection with its fuel conservation campaign were shown at the April meeting of the New York Railway Club. The western roads have always had more or less difficulty with their fuel supply and it has been necessary for them to study conservation methods to a greater extent than on roads in most of the other parts of the country.

A number of years ago the Northern Pacific equipped a fuel instruction car which has been sent back and forth over the system with excellent results. It is not an easy task to interest the average fireman or engineer in the theory of cumbustion and yet those in charge of this work on the Northern Pacific were able to develop a series of demonstrations that not only held the interest of the men, but inspired them to perform their work in such a way as to make the best use of the technical instruction that had been imparted to them. The management felt it necessary to intensify the fuel conservation educational work during the war because of the higher cost of fuel and the number of new men that it was necessary to employ on the locomotives. Careful consideration seemed to indicate that moving pictures could profitably be added to the equipment of the fuel instruction car in order to drive home and emphasize more forcefully the most important factors involved in an aggressive and successful fuel conservation campaign. Fortunately, those in charge recognized the necessity of having these pictures taken under the supervision of a moving picture expert and the results are really remarkable.

It is difficult at first thought to see how moving pictures could be used to demonstrate the advantages of single scoop firing, the abuses of popping, or the wastefulness in handling fuel. The moving picture expert and the fuel instruction expert working together have made it possible to tell the story simply and clearly and with the same effectiveness that is so characteristic of the high grade moving pictures. These pictures have been shown not only in the fuel instruction car on the Northern Pacific, but in various halls and meeting places at the more important cities and division points. When shown in the latter way, the townspeople are often invited to attend and are given suggestions as to the use of fuel in the home that have undoubtedly been productive of good results. An outline of how the work is carried out in detail on the Northern Pacific will be found elsewhere in this issue.

The Piece Work Question

Piece work is now a thing of the past on the railroads. There are those who believe that Director General McAdoo's order No. 8 was directly responsible for this because of the encouragement it gave to the extension of the union labor movement among railroad employees. The most important direct factor, however, was the increase in the hourly rate of the men without any corresponding increase in the piece work rates. It is contended by the Railroad Administration that there was so much dishonesty in the application of piece work that it was in the interests of the railroads to abolish it. Dishonesty, however, is something that cannot very well be instantly cured by rules or regulations. It is something that must be patiently dealt with through extended processes of education, in order to raise the moral standards of the individual or the group. It is doubtful, judging from various investigations that have been made, whether there is not an even greater amount of dishonesty under present conditions than could formerly have existed; this is indicated by the falling off in the productive output of the individual now that piece work has been abolished.

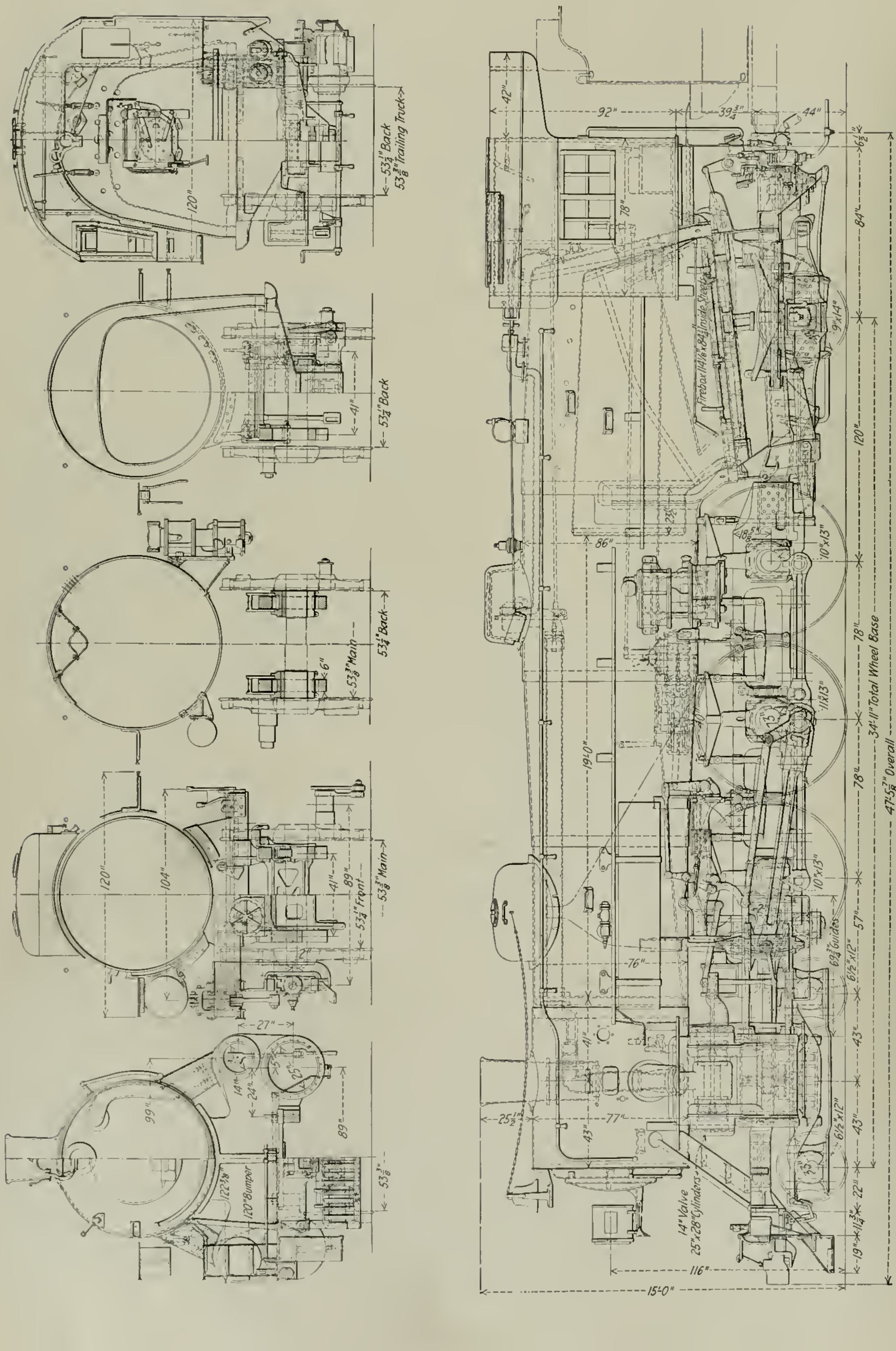
The important thing, however, at this time is not to lament the passing of piece work, but rather to study how to reorganize in such a way as to secure the best possible results under day work conditions. Manifestly, the supervision and practices and methods used formerly cannot give the best results under present conditions. Two things are absolutely vital to a successful solution of the problem. We almost hesitate to mention them, because, although the *Railway Mechanical Engineer* has advocated them for years, comparatively few railroad officers seem to have taken them seriously enough to make a real effort to promote them.

In the first place, a real, definite, aggressive effort must be made to educate not only the apprentices (and very few railroads have done this in the past), but also the men who have been in the service for long periods of time. Just because a man is classed as a mechanic, does not mean that he really understands how to do his job or knows the best way in which to do it. Very few things could be done with such telling results as to go at this matter in a serious way and utilize the best thought along these lines which has been developed in the industries and also in different branches of our army during the war. The next thing that should be done is to establish real schedules for doing the work, and this is particularly true in the locomotive repair shops. Not the least important result of the installation of such schedules is that weaknesses in the organization or defects in the methods and practices are automatically located and corrected. These suggestions are not theoretical. They are eminently practical and have been used with excellent results. It is unfortunate, however, that mechanical department officers as a whole have not had sufficient vision to recognize their value and to put them into effect.

NEW BOOKS

Proceedings of the International Railway Fuel Association. Edited by J. G. Crawford, secretary. 194 pages, 6 in. by 9 in., bound in leather. Published by the association, J. G. Crawford, secretary, 702 East 51st street, Chicago. Price, $1.50.

The tenth annual convention of the International Railway Fuel Association, which was held in Chicago last May, was an extremely important one, as it convened under the direct auspices of both the Railroad and Fuel Administrations. No better collection of railway fuel men was brought together at one gathering than at this convention. The papers read were not only inspiring, but full of great merit, and the prominence of the men that addressed the convention made these proceedings of great value. This book is a complete report of the convention and includes the following papers: Railroads and Their Relation to the Fuel Problem, by R. H. Aishton, regional director, U. S. R. A.; What the Canadian Railways Have Been Doing to Conserve Fuel, by Thomas Britt, general fuel agent, Canadian Pacific; Motive Power Men and Fuel Economy, by Robert Quayle, general superintendent motive power, Chicago & North Western; The Railroads' Industrial Army, by W. S. Carter, director, Division of Labor, U. S. R. A.; Relation of Locomotive Maintenance to Fuel Economy, by Frank McManamy, assistant director, Division of Operation, U. S. R. A.; Need for Fuel Conservation, by P. B. Noyes, director, Conservation Division, Fuel Administration; Fuel Oil and the War, by M. L. Requa, director, Oil Division, Fuel Administration; and Individual Effort Toward Fuel Saving, by Eugene McAuliffe of the Railroad Administration.



Elevation and Sections of the Standard Light Pacific Type Locomotive

Standard 4-6-2 Type Locomotives

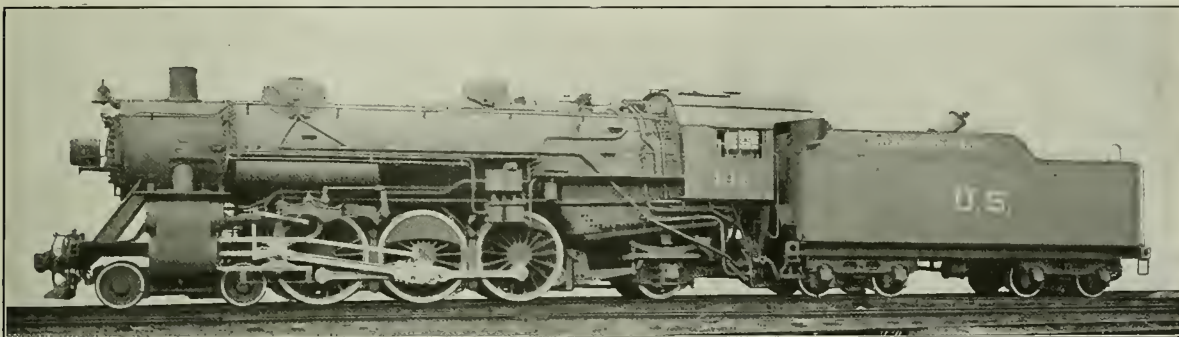
Both Light and Heavy Classes Have Many Details Interchangeable with the Other Standard Designs

The first of the two classes of Pacific type locomotives built to the United States Railroad Administration's standard designs have recently been turned out of the Richmond Works of the American Locomotive Company, the light locomotive for delivery to the Atlantic Coast Line and the heavy locomotive for delivery to the Erie. The light locomotive is one of a total of 59 of these locomotives which have been ordered by the Railroad Administration, 26 to be built by the American Locomotive Company and 33 by the Baldwin Locomotive Works. Orders have been placed for a total of 20 of the heavy locomotives, 10 with each of the above mentioned builders.

The light Pacific type was designed on the basis of driving wheel loads of 55,000 lb. per axle and has a total weight of 277,000 lb. in working order. The actual driving axle loads are 54,000 lb. each, and a tractive effort of 40,700 lb. is developed. In Table I will be found a comparison of this locomotive with a number of others of the same type designed on the basis of approximately the same axle loads. It will be seen that the standard locomotive is somewhat similar in its proportions to the Missouri, Kansas & Texas locomotive, which, however, has more heating surface, but a considerably smaller grate and a smaller ratio of firebox heating surface to total heating surface.

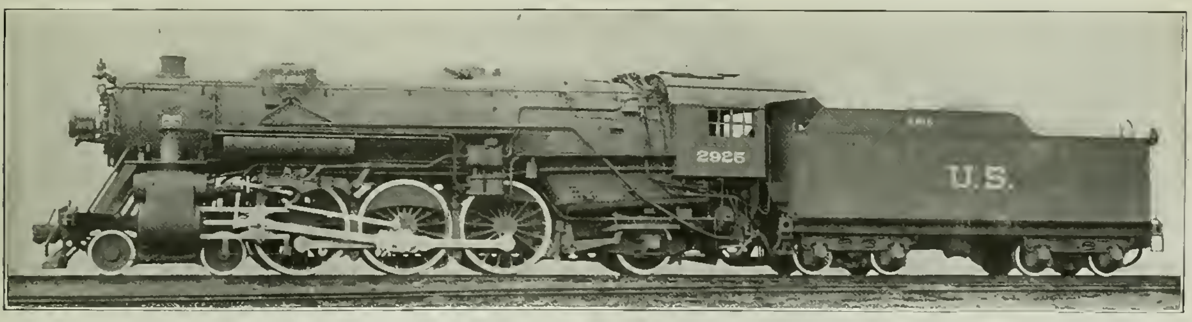
The design of the heavy Pacific locomotive was based on driving axle loads of 60,000 lb. The actual weight on drivers, however, is 197,000 lb., equivalent to slightly less than an average of 66,000 lb. on each axle. The total weight of this locomotive in working order is 306,000 lb. and it has a maximum tractive effort of 43,900 lb.

In Table II will be found a comparison of this locomotive with several other heavy Pacific type locomotives. The heavy standard locomotive compares more closely with the Pennsylvania K4s Pacific than with any of the others. It has about 4,000 lb. less weight on drivers than the Pennsylvania locomotive, with a total weight 3,000 lb. less, and on a comparative basis is rated at 600 lb. less starting tractive effort. A comparison of the heating surfaces of the two locomotives would indicate that the Pennsylvania locomotive had a considerably greater capacity for high sustained speed when handling similar loads.

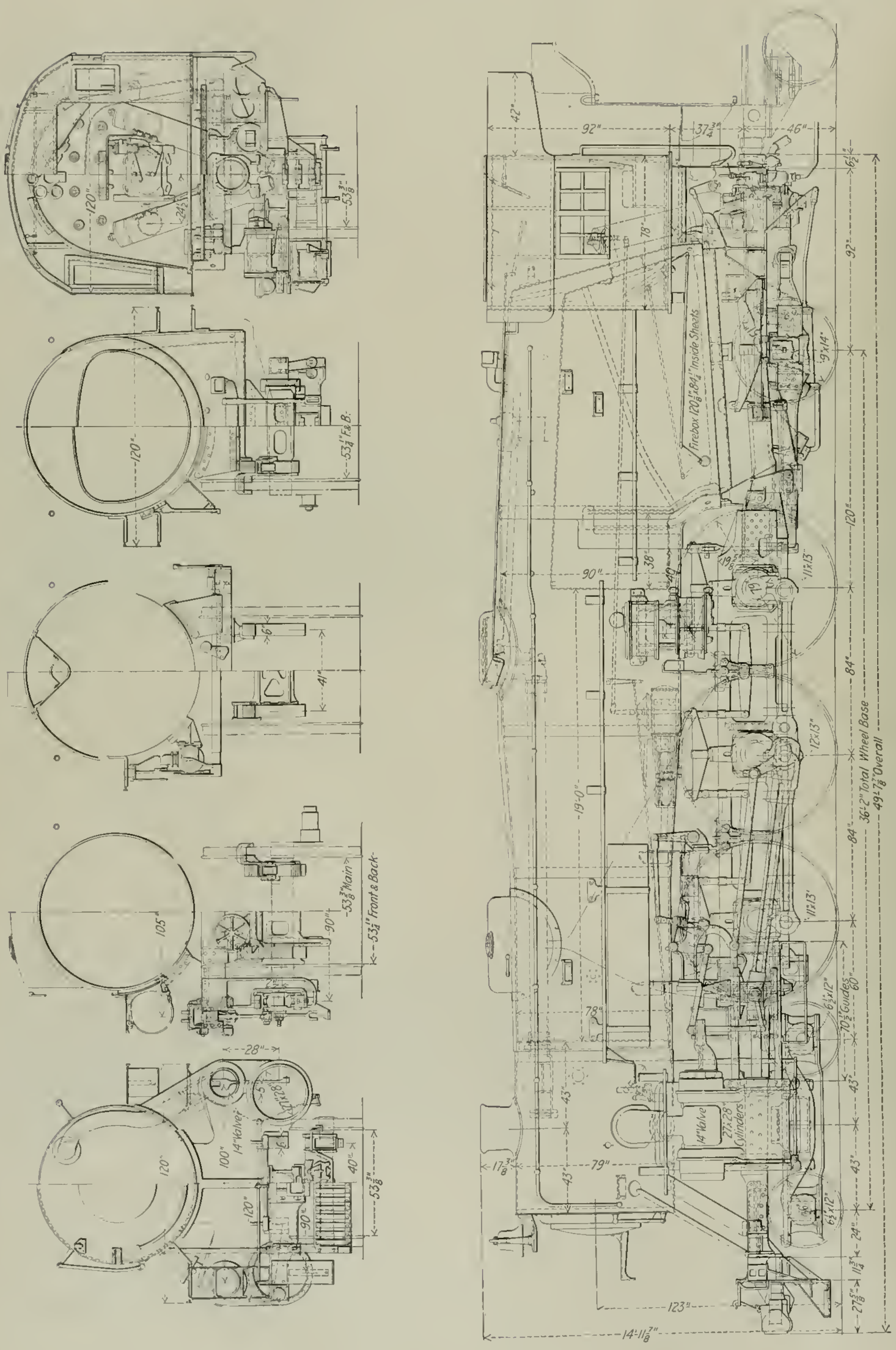


The Standard Light Pacific Type Locomotive

The boilers of the two standard Pacific type locomotives are generally similar in construction, both being of the conical wagon top type with combustion chamber fireboxes. The outside diameter at the first ring of the two boilers is 76 in. and 78 in., respectively, increasing to 86 in. and 90 in., respectively, at the dome course. The light locomotive has 188 2¼-in. tubes and 36 5½-in. flues, while the heavy locomotive has 216 tubes and 40 flues of the same diameters. The tubes of both locomotives are 19 ft. long, while the combustion chamber of the light locomotive is 23½ in. long and that of the heavy locomotive 38 in. long. The maximum diameter of the boilers at the dome course is 86 in. for the light locomotive and 90 in. for the heavy locomotive. The light locomotive is hand fired, while the heavy engine is equipped with a Duplex stoker.

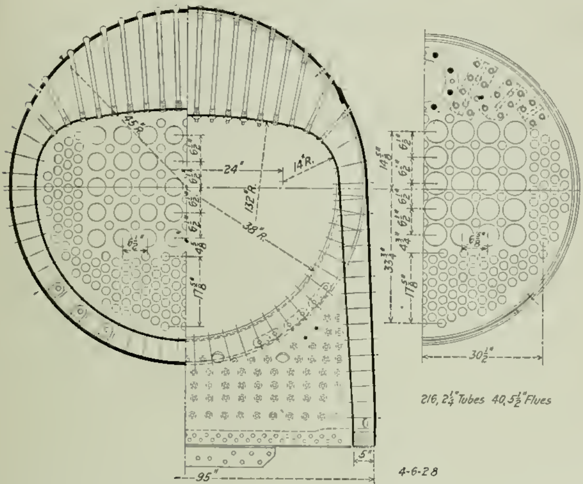


The Railroad Administration Standard Heavy Pacific Type Locomotive



Elevation and Sections of the Standard Heavy Pacific Type Locomotive

The design of the frames for both types is essentially the same. Both are of the single front rail type, each frame being cast in one piece with a splice back of the rear driving wheels for Commonwealth cradle castings. In both cases the frames are six inches wide. The lighter frames have a depth of top rail of 6⅛ in. over the driving boxes and a minimum depth of 5⅛ in. between the drivers. The maximum and minimum depths of the lower rail are 4¼ in. and 3¾ in.,



Half Sectional Views of the Firebox and Combustion Chamber and Half Tube Sheet Elevation

respectively. The frames for the heavy Pacific have a depth over the driving boxes of 7⅛ in. and a minimum depth of top rail of 6 in., while the maximum and minimum depths of the lower rail are 4¾ in. and 4¼ in., respectively.

The cylinders of both types are similar in design to those on all of the other single unit standard locomotives and both are designed for the use of 14-in. piston valves. Those of the light Pacific type are 25 in. in diameter, while the heavy locomotives have 27-in. cylinders, the stroke being 28 in. in both cases. The pistons are of the single plate dished type, used on all the other locomotives and that of the light Pacific interchanges with the crosshead of the eight-wheel switcher and the light Mikado type locomotive. While none of the cylinder designs are interchangeable, the front and back heads

Table I—Comparison of Light Pacific Type Locomotives

Road	U. S. R. A.	M. K. & T.	C. B. & Q.	N. Y. N. H. & H.
Year built	1919	1915	1915	1916
Tractive effort, lb.	40,700	40,700	42,000	40,800
Total weight, lb.	277,000	272,000	266,400	266,000
Weight on drivers, lb.	162,000	165,000	169,700	165,000
Diameter, drivers, in.	73	73	74	79
Cylinders, diameter and stroke in.	25 by 28	25 by 28	27 by 28	26 by 28
Boiler pressure, lb.	200	200	180	200
Heating surface, total, sq. ft.	3,333	3,838	3,364	3,315
Superheating surface, sq. ft.	794	870	751	776
Grate area, sq. ft.	66.7	57.5	58.7	59.2
Tractive effort × dia. drivers ÷ equivalent heating surface	656.7	577.0	693.0	719.6
Equivalent heating surface ÷ grate area	67.8	89.5	76.4	75.7
Firebox heating surface ÷ equivalent heating surface, per cent	5.8	4.8	6.5	6.7

have been made interchangeable where the diameter of the cylinders is the same, those for the light Pacific interchanging with the Eight-wheel switcher, and those for the heavy

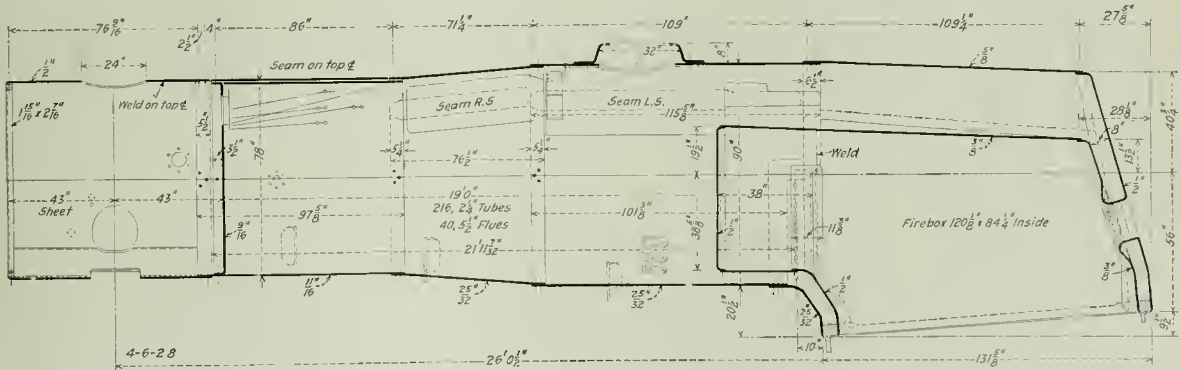
Table II—Comparison of Heavy Pacific Type Locomotives

Road	U. S. R. A.	P. R. R.	D. L. & W.	L. V.
Year built	1919	1914	1915	1916
Tractive effort, lb.	43,900	44,500	47,506	48,800
Total weight, lb.	306,000	308,900	305,000	301,500
Weight on drivers, lb.	197,000	201,800	197,300	192,200
Diameter drivers, in.	79	80	73	73
Cylinders, dia. and stroke, in.	27 by 28	27 by 28	27 by 28	27 by 28
Boiler pressure, lb.	200	205	200	205
Heating surface, total, sq. ft.	3,824	4,035	3,680	4,103
Superheating surface, sq. ft.	887	1,154	760	75
Grate area	70 8	70	91.3*	75
Tractive effort × dia. drivers ÷ equivalent heating surface.	672.9	580.6	719.4	639.2
Equivalent heating surface ÷ grate area	72.8	82.3	52.8	74.3
Firebox heating surface ÷ equivalent heating surface, per cent	6.3	5.0	7.7	6.6

*For anthracite coal.

Pacific interchanging with the heavy Mikado and the light Santa Fe and Mountain type locomotives.

Both the main and side rods are of channel section, the rod design for all of the standard locomotives being the same

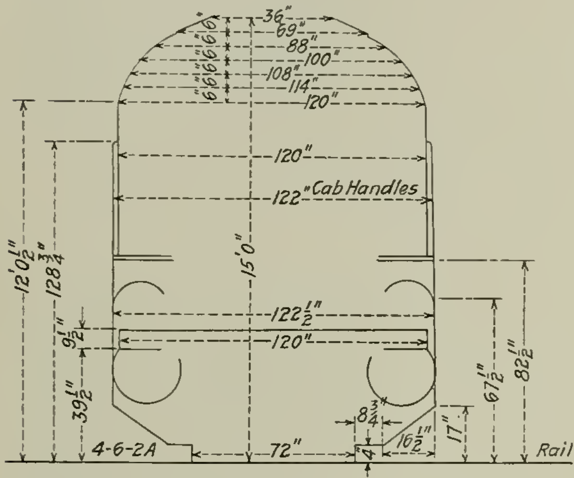


Boiler for the Heavy Pacific Type Locomotive

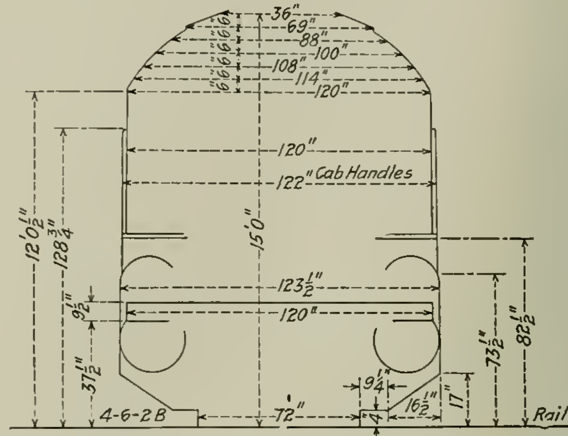
the specifications calling for either cast or rolled steel, with a cast iron bull ring and packing rings of Hunt-Spiller gun iron. In both cases the cylinders and valve chambers are fitted with the Hunt-Spiller gun iron bushings. The piston and rod of the light Pacific type are interchangeable with those of the eight-wheel switcher, while the piston on the heavy Pacific type interchanges with that used on the heavy Mikado and Mountain type locmotives and the light Santa Fe type. The crosshead is also essentially the same as that in details with the exception of the necessary variation in dimensions. The two Pacific type locomotives are the only ones having the channel section side rods, the others all being of slab section.

Wherever the journal sizes permit, the driving boxes have been made interchangeable on all of the locomotives. The light Pacific type locomotive has main journals 11 in. in diameter by 13 in. in length, while the front and back journals are one inch less in diameter. The front and back driving journals of the heavy Pacific are the same size as those of the main journals on the light Pacific, while the main journals of the heavier locomotive are 12 in. in diameter by 13 in. in length.

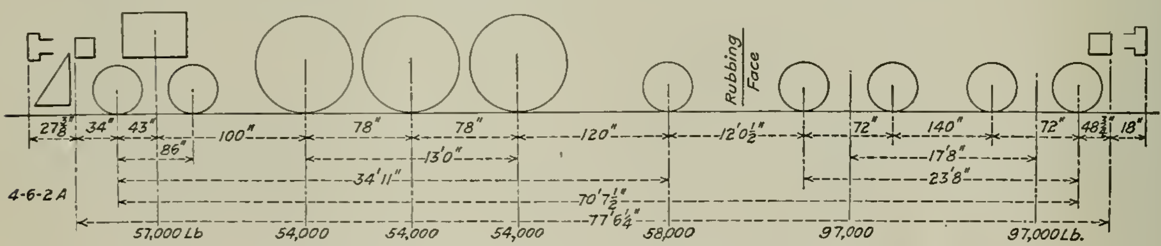
Both locomotives have the constant resistance type engine truck with 6½-in. by 12-in. journals and 33-in. wheels, while the trailer trucks are of the Cole-Scoville design with 43-in. wheels and 9-in. by 14-in. journals. A considerable degree of interchangeability exists between the details of this type of truck in use on the standard Mountain and Pacific type locomotives, although complete interchangeability of the trucks as a whole has not been maintained in every case.



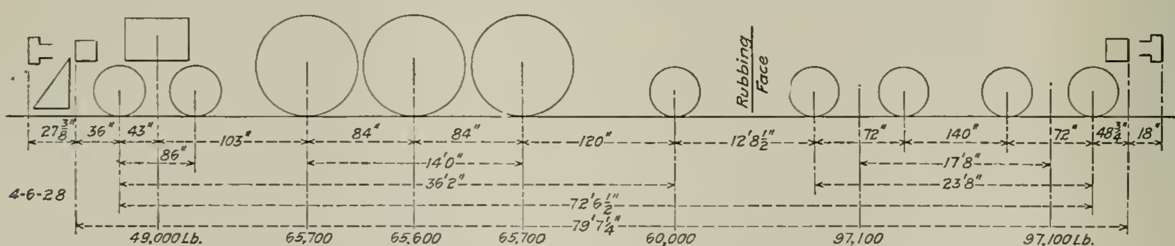
Clearance Diagram for the Light Pacific Type Locomotive



The Heavy Pacific Type Clearance Diagram



Distribution of the Weight of the Light Pacific Type Locomotive



Distribution of the Weight of the Heavy Pacific Type Locomotive

The tenders of both locomotives are built with Commonwealth cast steel frames and have tanks of 10,000-gal. capacity. The tender trucks for both are of the Commonwealth equalized type, differing from the trucks under the heavy Mountain type, which were equalized swing motion trucks of the locomotive builder's design.

Aside from the parts already mentioned a large measure of interchangeability has been carried throughout the various standard designs, including a large number of minor details, such as rod brasses, grate frames, bumper beams, many of the small castings, and in a number of cases, crank pins, axles and springs as well. A complete list of the specialties on all of the standard locomotives was published in the March, 1919, issue of the *Railway Mechanical Engineer,* on page 137.

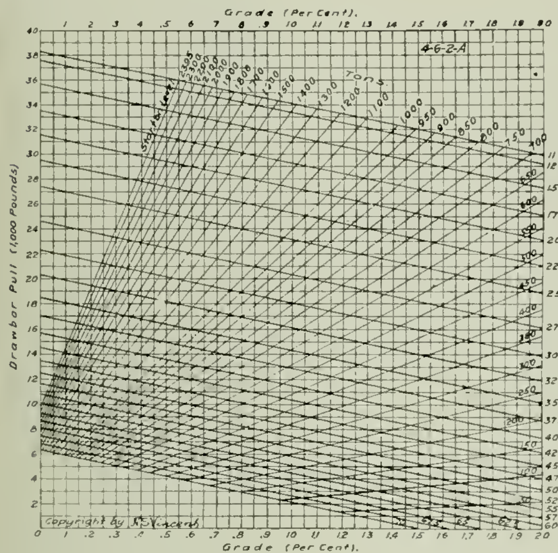
Tonnage rating charts are shown, which were prepared by H. S. Vincent, and the clearance and wheel load diagrams were prepared by F. P. Pfabler, chief mechanical engineer, division of operation, of the Railroad Administration. The distribution of wheel loads as shown are actual weights of the completed locomotives.

The principal dimensions and data for the two Pacific type locomotives are as follows:

General Data

	Light 4-6-2	Heavy 4-6-2
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Service	Passenger	Passenger
Fuel	Bit. coal	Bit. coal
Tractive effort	40,700 lb.	43,900 lb.
Weight in working order	277,000 lb.	306,000 lb.

Weight on drivers	162,000 lb.	197,000 lb.
Weight on leading truck	57,000 lb.	49,000 lb.
Weight on trailing truck	58,000 lb.	60,000 lb.
Weight of engine and tender in working order	471,000 lb.	500,200 lb.
Wheel base, driving	13 ft.	14 ft.
Wheel base, total	34 ft. 9 in.	36 ft. 2 in.
Wheel base, engine and tender	68 ft. 7½ in.	70 ft. 8½ in.
Ratios		
Weight on drivers ÷ tractive effort	4.0	4.5
Total weight ÷ tractive effort	6.8	7.0



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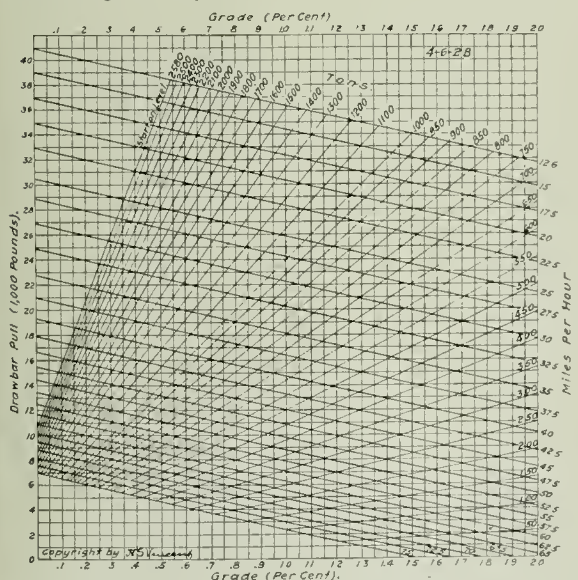
Tonnage Rating Chart for the Standard Light Pacific Type

Tractive effort × diam. drivers ÷ equivalent heating surface*	656.7	672.9
Equivalent heating surface* ÷ grate area	67.8	72.8
Firebox heating surface ÷ equivalent heating surface,* per cent.	5.8	6.3



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Tonnage Rating Chart for the Standard Heavy Pacific Type

Weight on drivers ÷ equivalent heating surface*	35.8	38.2
Total weight ÷ equivalent heating surface*	61.2	59.4
Volume both cylinders	15.0 cu. ft.	18.6 cu. ft.
Equiv. heat. surface* ÷ vol. cyls.	284.4	277.1
Grate area ÷ vol. cylinders	4.2	3.8

Cylinders		
Kind	Simple	Simple
Diameter and stroke	25 in. by 28 in.	27 in. by 28 in.
Valves		
Kind	Piston	Piston
Diameter	14 in.	14 in.
Wheels		
Driving, diameter over tires	73 in.	79 in.
Driving journals, main, diameter and length	11 in. by 13 in.	12 in. by 13 in.
Driving journals, others, diameter and length	10 in. by 13 in.	11 in. by 13 in.
Engine truck wheels, diameter	33 in.	36 in.
Engine truck, journals	6½ in. by 12 in.	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.	43 in.
Trailing truck, journals	9 in. by 14 in.	9 in. by 14 in.
Boiler		
Style	Con. W. T.	Con. W. T.
Working pressure	200 lb. per sq. in.	200 lb. per sq. in.
Outside diameter of first ring	76 in.	78 in.
Firebox, length and width	114⅛ in. by 84¼ in.	130⅛ in. by 84¼ in.
Firebox plates, thickness	Tube, ½ in.; others, ⅜ in.	Tube, ½ in.; others, ⅜ in.
Firebox, water space	Front, 5 in.; others, 4 in.	Front, 5 in.; others, 4 in.
Tubes, number and outside diameter	188—2¼ in.	216—2¼ in.
Flues, number and outside diameter	30—5½ in.	40—5½ in.
Tubes and flues, length	19 ft. 0 in.	19 ft. 0 in.
Heating surface, tubes	2,091 sq. ft.	2,407 sq. ft.
Heating surface, flues	981 sq. ft.	1,090 sq. ft.
Heating surface, firebox†	261 sq. ft.	327 sq. ft.
Heating surface, total	3,333 sq. ft.	3,824 sq. ft.
Superheater heating surface	794 sq. ft.	887 sq. ft.
Equivalent heating surface*	4,524 sq. ft.	5,154 sq. ft.
Grate area	66.7 sq. ft.	70.8 sq. ft.
Tender		
Tank	Water Bot.	Water Bot.
Frame	Cast Steel	Cast Steel
Weight	194,000 lb.	194,200 lb.
Water capacity	10,000 gal.	10,000 gal.
Coal capacity	16 tons	16 tons

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.
† Includes arch tube heating surface.

I. C. C. REVISES LOCOMOTIVE INSPECTION RULES

On September 20, 1917, the Interstate Commerce Commission issued an order putting into effect a number of modifications and suspensions of the locomotive inspection rules. The changes were made at the request of the railroads because of the difficulty of meeting some of the requirements of the rules with a shortage of competent labor and a lack of sufficient material, without seriously curtailing the supply of motive power to handle the extraordinary traffic movement required to supply the war needs of the country. Since the signing of the armistice the readjustment of the industrial activities of the country and the demobilization of the army have changed the conditions which the modifications in the rules were intended to meet. An order reciting these facts, effective May 1, 1919, has been issued canceling the order of September 20, 1917, but making permanent such of the provisions of that order as experience has demonstrated may be made permanent without adversely affecting the safety of operation.

The new order modifies Rules 2, 10, 16, 23, 110, 112, 128, 142 and 150 to read as follows:

Rule 2—The lowest factor of safety for locomotive boilers, which were in service or under construction prior to January 1, 1912, shall be 3.25.

Effective October 1, 1919, the lowest factor shall be 3.5.

Effective January 1, 1921, the lowest factor shall be 3.75.

Effective January 1, 1923, the lowest factor shall be 4.

Rule 10. Flues to be Removed—All flues of locomotive boilers in service, except as otherwise provided, shall be removed at least once every four years for the purpose of making a thorough examination of the entire interior of the boiler and its bracing. After the flues are taken out, the inside of the boiler must have the scale removed and be thoroughly cleaned and inspected. The removal of flues will be due after 48 calendar months' service, provided such service is performed within five consecutive years. Portions of calendar months out of service will not be counted. Time out of service must be properly accounted for by out of service reports and notations of months claimed out of service made on the back of each subsequent inspection report and cab card. The period for removal of flues, upon formal application to the chief inspector, may be extended, if investigation shows that conditions warrant it.

Rule 16. Lagging to be Removed—The jacket and lagging shall be removed at least once every five years and a thorough inspection made of the entire exterior of the boiler while under hydrostatic pressure. The jacket and lagging shall also be removed whenever on account of indications of leaks the United States inspector or the railroad company's inspector considers it desirable or necessary.

The modification granted in Rule 16, in the Commission's Order of September 20, 1917, on account of the war, in which the date for removal of jacket and lagging was advanced for a period equivalent to the duration of the war, such advanced period shall be considered two years.

Rule 23. Method of Testing Flexible Staybolts with Caps—All flexible staybolts having caps over the outer ends shall have the caps removed at least once every two years, and also whenever the United States inspector or the railroad company's inspector considers the removal desirable in order to thoroughly inspect the staybolts.

The firebox sheets should be examined carefully at least once a month to detect any bulging or indications of broken staybolts. Each time a hydrostatic test is applied, the hammer test required by Rules 21 and 22, shall be made while the boiler is under hydrostatic pressure, not less than the allowed working pressure, and proper notation of such test made on Form No. 3.

Rule 110. Time of Cleaning—Distributing or control valves, reducing valves, triple valves, straight-air double-check valves and dirt collectors shall be cleaned as often as conditions require to maintain them in a safe and suitable condition for service, but not less frequently than once every six months.

Rule 112. (a). Piston Travel—The minimum piston travel shall be sufficient to provide proper brake shoe clearance when the brakes are released.

(*b*). The maximum piston travel when locomotive is standing shall be as follows:

Cam type of driving wheel brake	3½ in.
Other forms of driving wheel brake	6 in.
Engine truck brake	8 in.
Tender brake	9 in.

Rule 128 (a). Rods, Main and Side—Cracked or defective main or side rods shall not be continued in service.

(*b*) Autogenous welding of broken or cracked main and side rods not permitted.

(*c*) Bearings and bushings shall so fit the rods as to be in a safe and suitable condition for service, and means be provided to prevent bushings turning in rod. Straps shall fit and be securely bolted to rods.

(*d*) The total amount of side motion of rods on crank pins shall not exceed ¼ in.

(*e*) Oil and grease cups shall be securely attached to rods, and grease cup plugs shall be equipped with suitable fastenings.

(*f*) *Locomotives Used in Road Service*—The bore of main rod bearings shall not exceed pin diameters more than 3-32 in. at front or back end. The total lost motion at both ends shall not exceed 5-32 in.

(*g*) The bore of side rod bearings shall not exceed pin diameters more than 5-32 in. on main pin, nor more than 3-16 in. on other pins.

(*h*) *Locomotives Used in Yard Service*—The bore of main rod bearings shall not exceed pin diameters more than ⅛ in. at front end, or 5-32 in. at back end.

(*i*) The bore of side rod bearings shall not exceed pin diameter more than 3-16 in.

Rule 142 (a) Spring Rigging—Springs and equalizers shall be arranged to insure the proper distribution of weight to the various wheels of the locomotive, maintained approximately level, and in a safe and suitable condition for service.

(b) Springs or spring rigging with any of the following defects shall be renewed or properly repaired:

(*c*) Top leaf broken or two leaves in top half or any three leaves in spring broken. (The long side of spring to be considered the top.)

(*d*) Springs with leaves working in band.

(*e*) Broken coil springs.

(*f*) Broken driving box saddle, equalizer, hanger, bolt, or pin.

Rule 150 (a) Driving and Trailing Wheel Tires—The minimum height of flange for driving or trailing wheel tires, measured from tread, shall be one inch for locomotives used in road service, except that on locomotives where construction will not permit the full height of flange on all drivers, the minimum height of the flange on one pair of driving wheels may be ⅝ in.

(*b*) The minimum height of flange for driving wheel tires, measured from tread, shall be ⅞ in. for locomotives used in switching service.

(*c*) The maximum taper for tread of tires from throat of flange to outside of tire, for driving and trailing wheels for locomotives used in road service, shall be ¼ in., and for locomotives used in switching service, 5-16 in.

(*d*) The minimum width of tires for driving and trailing wheels of standard-gauge locomotives shall be 5½ in. for flanged tires, and 6 in. for plain tires.

(*e*) The minimum width of tires for driving and trailing wheels of narrow-gauge locomotives shall be 5 in. for flanged tires, and 5½ in. for plain tires.

(*f*) When all tires are turned or new tires applied to driving and trailing wheels, the diameter of the wheels on the same axle, or in the same driving wheel base, shall not vary more than 3-32 in. When a single tire is applied, the diameter must not vary more than 3-32 in. from that of the opposite wheel on the same axle. When a single pair of tires is applied, the diameter must be within 3-32 in. of the average diameter of the wheel in the driving wheel base to which they are applied.

(*g*) Driving and trailing wheel tires with any of the following defects shall not be continued in service:

(*h*) Slid flat spot 2½ in. or more in length; flange 15-16 in. or less in thickness, gaged at a point ⅜ in. above the tread, or having flat vertical surface 1 in. or more from tread; tread worn hollow 5-16 in. on locomotives used in road service, or ⅜ in. on locomotives used in switching service; flange more than 1½ in. from tread to top of flange. (See figs. 1, 2 and 3.)

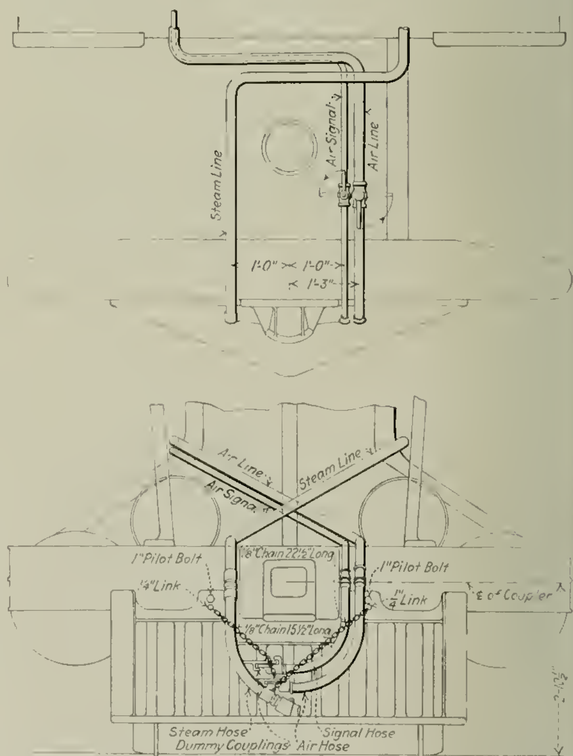
Note—The determination of flat spots and worn flanges shall be made by a gage as shown in fig. 8, and its application to defective tires, as shown in figs. 9, 10 and 11.

LOCATION OF TRAIN PIPES ON THE FRONT OF THE LOCOMOTIVE

BY H. SNECK
Supervisor of Air Brakes, Buffalo, Rochester & Pittsburgh

It is general practice to run the brake pipe and signal line on the front end of the locomotive out over the pilot beam on the right or engineman's side and the car heating steam line on the left side.

The front of a locomotive is the only piece of rolling stock that does not have the brake pipe on the right side when facing the front, according to the M. C. B. standard. Therefore, when coupling the hose on the front end of one locomotive to the rear of another locomotive or to a car both hose come together on the right side, causing the hose to buckle. This, to a great extent, reduces the opening through the hose and prevents quick action from running by this point.



Arrangement of Train Line Pipes on the Front of Buffalo, Rochester & Pittsburgh Locomotives to Comply with M. C. B. Standard on Cars

The new location in which the pipes are crossed is just the reverse of the old and was brought about as a remedy for the inability at times to get the emergency application of the brakes to run by the second engine in a two-engine train. It will be noted in the drawing that all the hose cross under the coupler when connected up, which prevents any possibility of buckling. The M. C. B. standard dimensions may be used for the location of each pipe.

The Buffalo, Rochester and Pittsburgh has used this method on all locomotives for more than 10 years and it has proved very satisfactory.

Fuel Saving Methods on the N. P.

Fuel Instruction Car Employs Laboratory Demonstrations and Moving Pictures, and Brings Results

BY M. A. DALY
Fuel Supervisor, Northern Pacific

THE Northern Pacific links together Wisconsin, Minnesota, North Dakota, Montana, Idaho, Washington, Oregon and Western Canada; yet, we don't feel that we are very far from the east. I suppose this is because every year we go to West Virginia and Pennsylvania to buy coal with which to supply a large percentage of our locomotives throughout the following year. Nevertheless, it is a long distance to haul coal. The average rail haul is about 200 miles from the eastern mines to the Lake Erie ports, where the coal is loaded into ships. It is a 900-mile boat haul from the Lake Erie ports to Duluth. At Duluth the coal is again loaded into cars and hauled by rail as far west as the Missouri River, a distance of 500 miles. By the time it reaches its destination the coal has become very expensive —and that is just the reason why our people have felt compelled to do everything they could to get the greatest possible amount of heat out of every ton of coal used.

The necessity developed a campaign of fuel economy, beginning about eight years ago, and we have kept right at it ever since. It has been largely an educational movement, designed to interest not only the men who handle coal, but the officers who supervise the operating performances.

FUEL INSTRUCTION CAR

To introduce the work a passenger coach was fitted up as a traveling lecture room.** Chemical and physical apparatus was installed to demonstrate the properties of coal and the chemistry of combustion. Stereopticon views and motion pictures were added from time to time, as needed.

In passing over the line, at suitable intervals, the instruction car was located at places convenient for the men at the various division points. Locomotive and power-plant engineers and firemen, interested roundhousemen, despatchers, yardmasters, superintendents, trainmasters, master mechanics, road foremen and other local officers presented themselves for the various lectures. The responsibilities of individuals were reviewed, proper methods of handling coal were emphasized and fascinating possibilities were pointed out.

With all who are directly or indirectly concerned with fuel the plan has been to realize a common understanding of its great value, develop an appreciation of the actual losses in known wasteful practices, and to anticipate the enormous savings to be accomplished by concerted efforts, systematically and persistently applied.

It was made clear from the start that fuel saving was a non-departmental matter, that instead of being the work of one department it was a matter of interest for all departments. And it was easily shown that there was enough available glory to be obtained so that all departments could take some of the credit.

Beginning with the preparation of coal at the mines attention is given to all phases of distribution, consumption and accounting. But, since approximately 95 per cent of all railroad fuel is consumed on locomotives, it naturally follows that special attention is given to its use on locomotives. Just as some engines through improper condition may burn more coal than others (of the same class), so, some enginemen through improper operation may burn more than other

*Abstract of an address before the New York Railroad Club, April 18, 1919.

**A description of the car and an outline of the lectures which are given was published in the *Railway Age Gazette* of May 1, 1914, page 976.

enginemen, and some firemen through improper handling may burn more than other firemen.

According to observations on various railroads, one fireman may burn as much as three tons per trip more than other firemen in the same service, using the same engine, on a similar train, over the same piece of track, under identical conditions. Now, men in general take a natural pride in doing good work. Once show a man that he can give better service with less labor and you have confronted him with a double argument which is seldom wholly lost. Once convince a fireman that when coal is properly placed in the firebox it will make more steam and less clinkers, that the required steam pressure will be more uniform and more certain, that the trip will require less shoveling and less shaking, and you have a fireman who is on his way to open-minded appreciation of instructions.

About all that is required for good firing is a little care and attention, with proper intention. Any instructed fireman can supply the necessary care and attention, and become a good fireman.

TALKS IN INSTRUCTION CAR

Of the lectures in the instruction car, perhaps the thing that most impressed our enginemen and firemen were the chemical experiments illustrating how combustion may take place. In one instance, a wide mouthed bottle was inverted over a lighted candle to prove that when the contained oxygen was consumed burning stopped. Hydrogen was prepared. With a proper supply of oxygen a lighted match could explode it. With no oxygen present, this highly inflammable gas would extinguish a lighted match. Thus, after a series of similar experiments, it was conclusively shown that to have burning, oxygen must touch the fuel. Accordingly, it became clear to enginemen and firemen why it was necessary to have a draft bringing air through the grates into the firebox, and why air must constantly supply new oxygen to the pieces of coal throughout the burning firebed.

Considering then that since oxygen of the air is necessary for burning, and, since air cannot well pass through clinkers or banks in a firebed, it follows that clinkers and banks are not desirable things to have in a firebox. Following this line of thought, it is but a step to consider that while gas is being driven from each piece of coal that lies in the firebox, this gas cannot be burned unless oxygen comes in contact with it. It then becomes obvious that the best firebox condition is possible only when air is coming through every square foot of grate surface.

In one of the demonstrations a pound of coal is put into a retort, heat is applied and the gases driven off. The coke remaining is weighed and computations made on a blackboard, bringing out the fact that approximately one-half of the heat value of coal is in the gas. The gases themselves, having been collected in transparent jars, are then burned in various ways to illustrate proper and improper combustion. They can be burned with a clear, white flame, giving off intense heat, or may be burned with a dull, yellow, smoky flame, developing very little heat. One smoky flame and one white flame are placed under separate test tubes containing equal amounts of water. The white flame evaporated completely the water above it, using much less gas than the smoky flame. We had the smoky flame when the supply of oxygen was not sufficient to burn the flow of gas; that is, the smoky, imperfect, low-heat, extravagant combustion took place when the supply of gas was greater than could be burned by the available oxygen.

Here again was a direct comparison with the locomotive firebed. A fire that is fed, at short intervals, with small quantities of coal, properly scattered over the surface of the firebed, will give a dazzling white fire to be compared with the dull red fire that comes when a large quantity of coal is thrown in at one time. To the enginemen and firemen this latter "slugging" method begins to take on a new aspect; the greater the quantity of coal thrown in at one time the greater the quantity of gas which may be rapidly driven off. And of course, when the quantity of gas exceeds the proportionate flow of oxygen through the grates, the excess gas cannot be burned and will pass off as smoke, through the stack—wasted. Then they correctly conclude that since 50 per cent of the heat value of the coal is in the gas, their aim must be to burn as much of the gas as possible, and thus they are intellectually persuaded to lean toward light and frequent firing, which is clearly the more economical method, and at the same time much the easier.

Firemen were encouraged to experiment for themselves, and it was not long before enginemen and firemen were boasting of the fact that they were making trips on one or more tons of coal less than formerly.

Competition is encouraged by comparing different crews on similar runs, between certain points. Road foremen use tally counters to ascertain the number of scoops, while a pocket scales will tell the weight of an average scoop, allowing the determination of the approximate number of pounds of coal used on the trip.

This all becomes very interesting when facing the fact that our Mikado locomotives often leave terminals with $125 worth of coal on their tenders, and each locomotive may take on an additional $50 or $60 worth of coal at some intermediate coal dock.

Our strong point with firemen has been that the more care exercised in placing the coal in a firebox the less coal will be required on the trip. This fact was taught not only verbally but by actual demonstration. So successfully has the plan worked out that we have men who actually fire our heaviest Mikados with one scoop to a fire. Now, single scoop firing is very particular work. Every fireman has not the patience to work it out, to master it. We do not advocate it, but we do point it out as an ideal to which firemen may aspire. Those who can approach it use less coal than formerly. Those who can master it use the least coal with the least labor. We do not ask our firemen to fire to a diagram.

THE MOVIES

The value of self-criticism has not been overlooked as a means of aiding enginemen and firemen to raise the character of their service. By the use of motion pictures they have been enabled to see themselves as others see them. The result has been very gratifying.

(Mr. Daly then showed several hundred feet of motion picture films which demonstrated in a most forceful way the advantages and disadvantages of proper and improper firing and the losses due to wastefulness and carelessness. For instance, with the moving picture camera mounted on the tender, pictures were shown of firing by the single scoop method as compared to the ordinary methods. Not only did the pictures clearly show the movements of the fireman but at intervals the camera was elevated so that a view was obtained over the top of the cab showing the results at the stack. Pictures were also taken from the roadside showing the trains in motion and the effect of the proper and improper methods of firing as reflected in the amount of smoke from the stack.

Moving pictures were also shown of the wastefulness of overloading tender tanks, of carelessness in unloading and cleaning out coal cars, and of the losses due to popping. In order to maintain interest on the part of the men, particularly during the period of the war, pictures were interposed showing the great need for fuel conservation in order to reduce to a minimum the number of cars required. Such pictures, for instance, might show the results of the freight congestion at the eastern seaboard, or the great trains of troops and munitions which it was necessary to transport, etc.

Typical individual pictures selected from the films are shown in the photographs, but, of course, they give no adequate idea of the forceful way in which poor or indifferent methods of firing can be contrasted by means of the movies.

RESULTS

Mr. Daly did not include in his paper any figures as to results secured on the Northern Pacific, but during the discussion he was questioned as to this and as to the size of the locomotives on the Northern Pacific. His reply showed that the average tractive power of the freight locomotives in service was high. He was also able to furnish the following figures as to fuel consumption which are taken from reports recently issued by the Fuel Conservation Section of the United States Railroad Administration:

FREIGHT SERVICE

	Pounds of coal per locomotive mile		Pounds of coal per 1,000 gross ton mile	
	December, 1918	January, '19	December, '18	January, '19
N. P.	241	237	162	175
G. N.	279	277	213	221
C. B. & Q.	304	294	223	221
C. & N. W.	275	285	226	242
U. P.	310	291	235	226
C. R. I. & P.	244	255	247	256
M. P.	217	240	176	200
Erie	307	299	206	210
Southern	282	312	281	320
A. T. & S. F.	262	265	209	216
C. M. & St. P.	273	251	212	219

EDITOR.)

DISCUSSION BY GEORGE M. BASFORD

Let's get our heads out of the sand. Our nation must get out of the wasteful class. It must get over thinking that its resources are limitless. It must conserve many things, first of all coal. Coal comes in train loads. There are other train loads waiting to be moved and all hands on a railroad naturally feel that anything so easy to get is somewhat like dirt and therefore is cheap.

With wages up, probably to stay, and with coal costs doubled, the locomotive must be looked at in a new light. The present generation is to be held accountable for its stewardship. In a large sense it is to be tried on the charge of wasting coal.

Let us acknowledge and appreciate everything that the government and the railroads are doing to improve the firing of coal and the management of the coal itself. Great improvements are being made in this direction. However, we must not overlook the fact that the best of coal and the best management of the fire may be nullified by the locomotive itself if the machine is not what it ought to be. This is being overlooked today in the case of thousands of old engines.

What is wanted is to put the locomotive in shape for its various parts to pull together to use the coal to best advantage. Boilers should not send wet steam to the cylinders. Fireboxes should not send unmixed and therefore unburned gases to the flues. Tender tanks should not send water to the boiler unheated by waste heat. There are a lot of other ways in which many old engines are working against themselves for lack of modern means for conserving their faculties and abilities. Even the best of firing of itself cannot insure the proper development of the heat of the coal or its use in producing power. The engine must have the means properly to make and use the power that is in the coal.

How about the 25,000 locomotives that as to power remain as they were built and are ten or more years old? Unless these engines are brought up to date they are antiquated, obsolete and an encumbrance as to power and as to the waste of fuel. Many of these engines were ten or more years old when they were built. This was because of bridge or other weight limitations. Today they are in the class of the old Rodman cast iron cannon, whereas we have Hindenburg lines to deal with today.

Think for a moment of the taking of the Hindenburg line. No small factor in the achievement was the confidence the men had in their equipment. They knew that this country had not sent them out without the best of everything to fight with. The inspiration of this confidence was necessary to success. Now think of the men who are handling these old engines we are talking about. What coal saving effort can you expect of men who know that the machine you give them wastes coal faster than they can save it?

In six years the coal consumption of locomotives has gone down from 3.6 lb. per draw bar horsepower to 2.25 lb., the figures being taken at the most efficient power of the engine. No parallel improvement has ever been made in six years in any other branch of engineering development.

This has been done by intelligent use of improved designs and by the employment of labor and fuel saving and capacity increasing factors which everybody knows about. These figures show what may be done and what is in everybody's mind to aim at with new engines, but why overlook the 25,000 old ones?

The fortunate feature of these improvements lies in the fact that they may be applied to all old engines that are in shape to run at all and they give these old engines increased power, making them, weight for weight, equal to the biggest, newest engines of the latest and best designs, and in many instances they will be better adapted for the work they are doing than new engines would be.

I mean that one big thing to do right now is to modernize those old engines—25,000 of them, applying to them the factors that make the modern locomotive take its place among the efficient power plants of the world. The way to do it is to make a survey of the old equipment in complete detail, to decide upon a modernizing program and determine the number of engines to be rejuvenated per month and then follow the program in spite of "hell and high water."

One of the roads that did this found that the improvements paid for themselves in seven months. Every $100 of cost earned $171.60 in the first year. This was 171 per cent investment. If the engines had but one year of life ahead of them it would have paid most handsomely. Did it pay? Is this one of the big economies? Does it not put in the shade all other locomotive economies that you can think of?

The steam locomotive of America is too big a factor in the success, stability and happiness of the nation to allow so large a proportion of antiquated equipment to be running hauling tons and hauling people at the high cost that these conditions entail. These old engines ought to be modernized or they ought to be scrapped, and that quickly.

The survey of the power on any railroad will reveal the merits of this question. It is my opinion that this survey is one of the most important immediate problems before the railroads. The best thing about it is that it can be done now, and that it will point out the best business policy of the roads—no matter who owns them.

A small engine need not be an uneconomical engine just because it is small. You need lots of small engines and always will need them. They should be put into the efficient class and their lives prolonged. By the way, this policy will overcome the extravagance of the past in the purchase of new power, much of which was necessary merely because there was so much unmodernized power on the road.

Some of you are thinking—"That's all right, but where is the money?" Let me tell you where the money is. It is blowing up the stack of every unmodernized engine. The entire first cost of modernizing is wasted in coal every seven to ten months on every one of these engines that is working. That's where the money is.

Did we back away from Germany because we didn't have the money for the war? We got the money!

You will find it easier to convince the hard-headed businessmen, the shippers, that you ought to have freight rate increases—after you have modernized these old engines. The shippers understand modernizing. That's why they succeed in business. That's why they have something to ship.

If you have had the inspiration of watching rival gun crews handling modern guns, you will appreciate the fact that, to do the work of today, which is greater work than that of yesterday, the guns must be *right*. It is not sufficient that the handling only should be right. The results are up to the right guns handled *right*. The more worthy the gun the better it will be served and the more it will do. This is exactly true of the locomotive. Every scoop of coal well fired does the more work when the engine is modernized. Modernizing augments every other means of saving. Let's get our heads out of the sand.

OTHER DISCUSSION

H. C. Woodbridge, fuel supervisor, Allegheny region, spoke particularly of the part transportation officers have in the conservation of fuel, mentioning a number of things not generally done now which they could do to reduce fuel consumption. When business is heavy it is now a common practice to start trains out from terminals whenever enough cars are available to make up a train, without regard to conditions at either the despatching or receiving terminals. He advocated the despatching of trains according to a predetermined plan, based on a careful study of the expected amount of business for any particular season, in which consideration has been given to conditions at terminals and important intermediate points on the division. In this way temporary congestion at terminal yards and engine terminals may be avoided and the power received only as fast as it can be handled. Such a plan has a marked influence on coal consumption through the elimination of delays en route and at the terminal.

The maximum allowable tonnage should be maintained, and tonnage should be reduced promptly to meet extraordinary conditions of weather, partial engine failures, etc. Tonnage trains should be given assistance out of the initial terminal to prevent delays in movement during the time in which the train is getting warmed up. Through loads should be segregated and pick-up work confined to certain trains rather than being handled hap-hazard by every train over the division. Train despatchers and tower men should be made to see clearly the effect on fuel consumption of slowing or stopping tonnage trains. Recommendations from trainmen as to the revision of schedules should be carefully considered; engines should be assigned and not pooled; the road foremen's time should not be taken up in conducting efficiency tests, etc., but devoted to supervising the operation of the locomotives on the road; the use of unnecessary lighting should be discouraged, and men should be disciplined for pulling apart air hose and allowing locomotives to waste steam at the pops. A close check should be kept on slow orders to eliminate their use or continuance except within absolutely necessary limits. The most efficient engines should be used and the inefficient ones scrapped or stored as opportunity permits.

Robert Collett, fuel supervisor of the Eastern region, laid stress upon the fact that nothing saves so much coal as an all-around good job of railroad operation. Any practice or plan which tends to improve general operating conditions is bound to reduce the consumption of fuel. Mr. Collett said that his conception of the function of the Fuel Conservation Section lay more in passing on the good things already being done from one road to another, than in initiating absolutely new practices. In dealing with the use of coal on the locomotive he suggested that more stress be placed on telling the men about their good performances than in continually criticising them for their failures. The business of a ralroad is to move trains and enginemen should not be critisised if they place more stress on keeping engines hot than upon the question of fuel economy, unless they have been thoroughly instructed in the best methods of firing and operating locomotives. As an evidence of the effect of operating conditions on fuel economy, he mentioned the fact that a 40 per cent difference in fuel used on the same passenger train on two succeeding days had been observed, where the principal difference in conditions lay in the necessity for stopping at block signals in one case, whereas a good run was made in the other.

Mr. Collett quoted from a comparative statement recently issued by the Fuel Conservation Section, which shows that the best results in reduction of fuel consumption on a gross ton-mile and passenger car mile basis have been obtained in the Central District of the Eastern region. Comparing the last six months of 1918 with the last six months of 1917, thus eliminating the effect of the extraordinary weather conditions prevailing during the early months of 1918, the average reduction in freight unit consumption for this district was 9.2 per cent and in passenger train-unit consumption 7.1 per cent. As shown by the available statistics, the total reduction in all regions was 5.5 per cent in freight service and 3.2 per cent in passenger service.

H. B. Brown, superintendent fuel department, Lehigh Valley, referred to the fact that, next to labor, fuel is the largest single item in railroad operating expenses and that the coal bill of the railroads was $150,000,000 greater in 1918 than in 1917, a fact which necessitates the redoubling of efforts to conserve coal from the standpoint of economy. He also referred to the necessity of fuel economy from the standpoint of the conservation of a natural resource which is not inexhaustible.

George L. Fowler called attention to the effect of proper firing methods on boiler repairs, stating that the opening and closing of the fire door produces a change in temperature of the firebox sheets reaching a maximum of 100 deg. F. in some parts of the firebox.

W. E. Symons referred to economies which could be effected in the 15 per cent of railroad fuel not burned in locomotives. By converting coal into producer gas for stationary power plant purposes, as high as $1.80 per ton may be realized from the sulphate ammonia, which is a by-product of the gas producer process.

Photograph by International Film Service Company, Inc., N. Y.

Belgian Workmen Beginning Reconstruction of the Railway Station at Ghent

The Resistance of Materials

The Effect of Sudden or Abrupt Changes in Section on the Distribution of the Unit Stress

BY G. S. CHILES AND R. G. KELLEY

III

FIGS 14a and 14b illustrate the unstrained and strained conditions of a strip of rubber perforated with a square hole as shown at *c*, Fig. 1, and in contact with glass plates as heretofore described. The pull which was exerted in this case was, as in the previous instances, five pounds. The stress action which is in evidence in this instance is somewhat similar to that which occurred in the case of the round hole with the exception that the maximum strain or deformation is found to take place at the corners of the hole. As in the case of the rounded openings, the compression at the upper and lower edges is again quite pronounced.

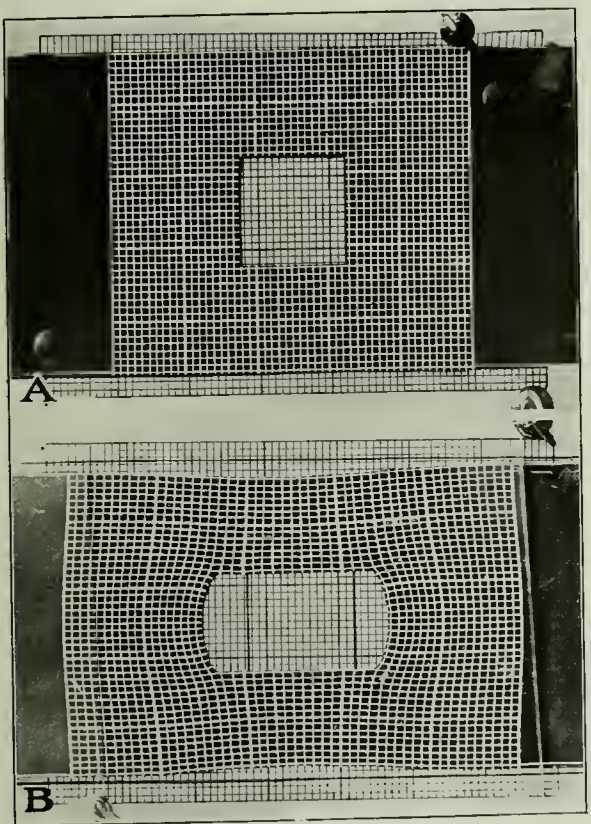


Fig. 14—Effect of a Square Hole on the Distribution of Stresses in a Rubber Sheet Under Tension

Table II summarizes briefly the data relative to the various rubber strips mentioned above.

TABLE II—DIMENSIONS, LOADS AND CALCULATED FIBER STRESSES OF SHEET RUBBER TEST SPECIMENS*

Line	Hole, 1½ in. diameter or square	Boss	Net sectional area, sq. in.	Total load, lb.	Calculated fiber stress lb. per sq. in.
1	Without	Without	0.1665	5	30
2	With	Without	0.111	5	45
3	Without	Without	0.1665	7	42
4	With	With	0.1836	7	38.2

*Specimens were 4½ in. wide by .037 in. thick; bosses were 3 in. in diameter and .048 in. thick.

Fig. 15 represents an eye bar designed in accordance with the standard practice of the American Bridge Company which calls for a maximum and minimum allowable thickness of one inch and one-half inch respectively.

Fig. 16*a* is a photographic reproduction of a model of the eye bar shown in Fig. 15 cut from rubber and having all of its dimensions exactly one-half of those of the standard eye bar of minimum thickness. The model was ruled up, as indicated in the photograph, in an unstrained condition

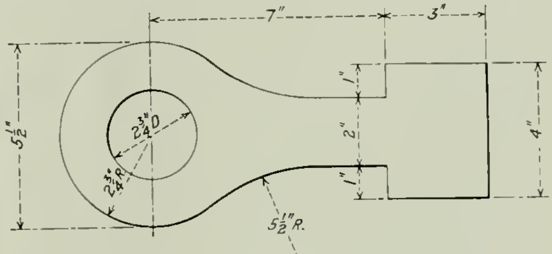


Fig. 15

with white ink lines spaced equally, ten to the inch, as heretofore described.

The lower end of the eye bar, the part having a width of four inches, was fastened to a soft pine board by means of a thin wooden strip as shown in Fig. 16*a*. The wood disk represents an eye bar pin. By exerting pressure on this disk the rubber was strained as shown in Fig. 16*b* and the

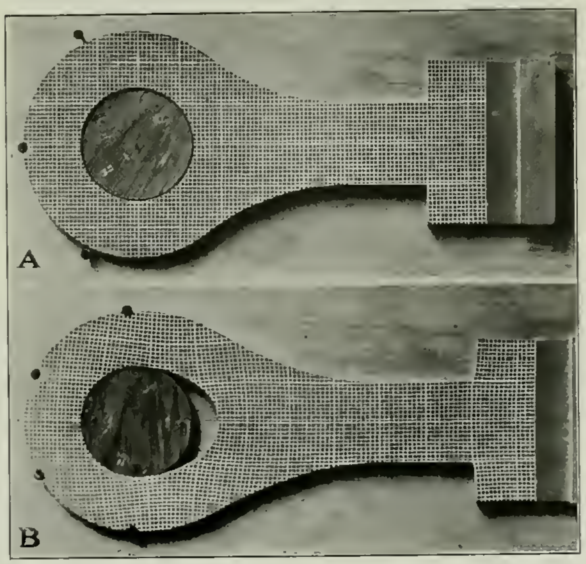
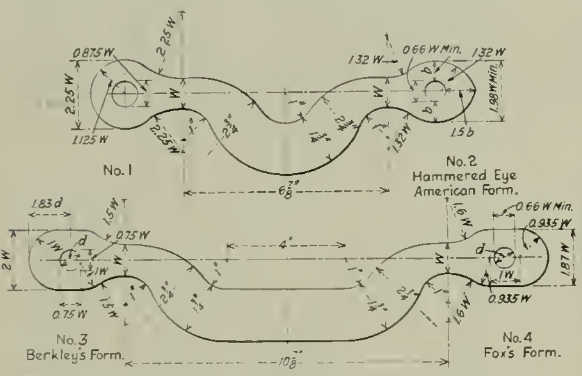


Fig. 16—Stresses Around the Pin in an Eye Bar

disk was then fastened with four small brads. It was found necessary to use tacks in order to keep the cutter rim of the circular end of the eye bar from buckling. The load was not measured in this experiment. The resulting deformation and stress distribution are plainly evident in the photograph and it will be noted that the stress action in the piece under strain in this photograph is quite similar to that illustrated in Fig. 12*c*, the similarity being quite marked along the edge of the hole which has been pulled away from the pin, and to a lesser degree along the edge in contact with the pin. The compression is again very noticeable at the lower edge of the hole. The lower white ink line, some ¾ in. above the upper edge of the wood strips, is not horizontal or parallel to the strip but is curved slightly near its center, a condition which becomes more pronounced near the offset portion. If



Note: Forms and proportions of eyes (in terms of W) No. 1—American Bridge Co. standard (2 inch width, 1½ inch maximum pin diameter) reduced one-half. Numbers 2, 3 and 4 see Machine Design, Construction and Drawing, by Spooner.

Fig. 17

a triangle is placed over Fig. 16*b* to coincide with the top four-inch line at the outer edges, this line, which was originally straight on the unstrained rubber, will be over 0.1 inch above the edge of the triangle near the vertical center line of the test piece. It is evident by comparing the horizontal lines near the projecting parts that these projections break up the uniform stress distribution so apparent an inch or so above.

Fig. 17 represents two different designs of offset tie bars each of which is provided with ends of different style. As stated in the legend beneath the drawings, the left end of the upper tie bar, marked No. 1, is designed in accordance with the American Bridge Company's standard practice, while the right end, No. 2, and ends No. 3 and No. 4 of the lower tie bar are designs abstracted from Spooner's "Machine Design, Drawing and Construction." It will be observed that the mid-section of the lower bar has a straight length of four inches and consequently is four inches longer than the mid-section of the upper bar, but that otherwise they have the same general dimensions up to the points where they meet the radii from the eye ends. The mid-section of the upper tie bar is a curved member, the inner and outer radius being purposely drawn from the same position. To this design a straight section was added, thus forming the lower design for the purpose of investigating the effect which this straight portion would have upon the deformation when the tie bars were subjected to the same load. The four designs of ends were used merely as a matter of interest and comparison, as it was considered that the difference in design would have no influence upon the stress action in the mid-section of the bars.

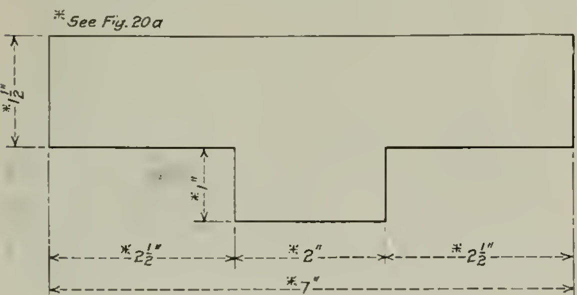


Fig. 18

Fig. 19*a* represents models of the tie bars cut to the dimensions shown on the drawings from rubber one-fourth-inch thick and ruled up, in an unstrained condition, with white lines spaced as previously described. For convenience in drawing comparisons between the unstrained and strained condition of the bars, the pine board upon which they were mounted was also ruled with corresponding lines, and the outline of the bars in their unstrained state drawn in. These

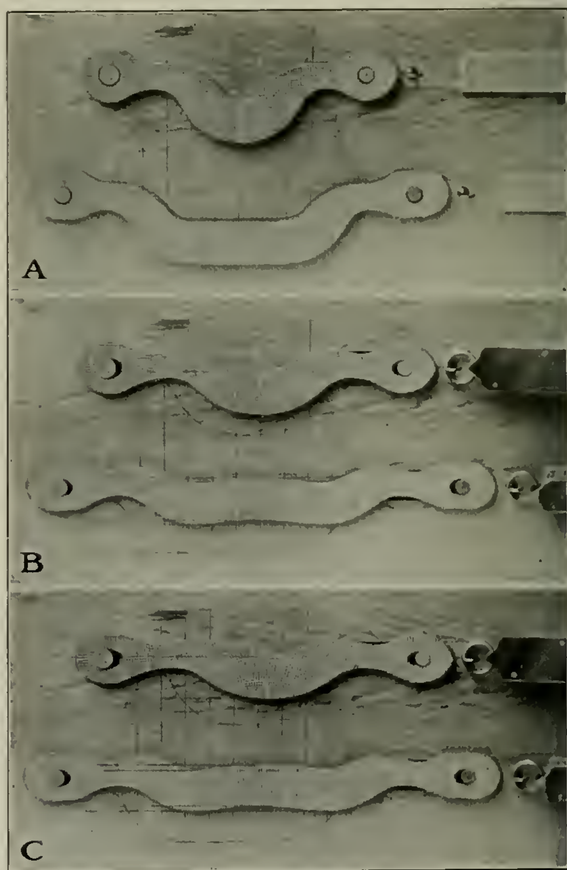


Fig. 19

pencil lines were drawn with the model in a horizontal (flat) position while the photographs were taken with it in a vertical (upright) position, as was true in all the experiments, and the weight of the test pieces together with slight pin clearances, accounts for the slight discrepancy between the actual and drawn contour of the eye bars in Fig. 19*a*. As in the case of Fig. 16*b* wooden disks were inserted in the eye ends to represent eye bar pins. In this experiment, however, the wooden disks on the right were fastened to a movable section of the stationary board.

Each of these tie bar models was subjected to two pulling loads of four pounds and seven pounds respectively and photographed in its distorted position under these loads as shown in Figs. 19*b* and 19*c*. From the reference lines on the board, it will be observed that the lower edge of the mid-section of the short bar is in compression and that the stress action, both as regards tension and compression, is more intense in the short bar than in the long bar.

The lower edge of the long bar for both loads measured very nearly the same as in the unstrained state showing that the tension due to the axial load is just sufficient to overcome or neutralize the compression due to the eccentricity of the load. There is very little tension along the upper edge of the neck of the short bar and practically no stress at the corresponding sections of the long bar. The most severe tension in the body of the short bar is along the curved part of the upper edge and a fairly high tension along the lower edge of the neck portions. In the long bar the most severe tension is in the curved parts on the upper

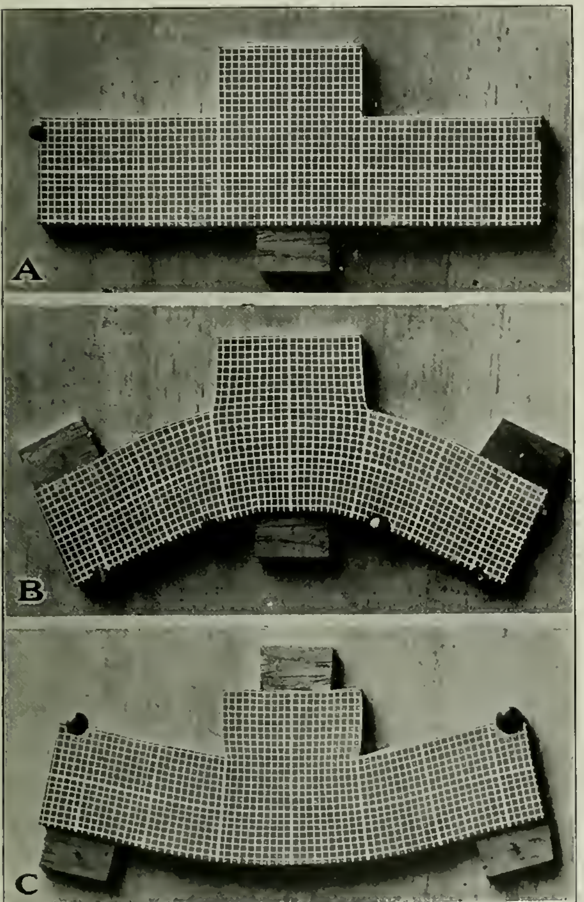


Fig. 20—The Effect of a Projecting Lug on Local Stresses in Rubber Specimen Subjected to Bending Loads

edge adjoining the straight portion. The tension along the lower edge of the neck of the long bar is greater than it is along the originally straight upper edge of the mid-section. The large deformation in these rubber tie-rods equalizes stress distribution to some extent.

In Fig. 19*b* it will be observed that, whereas Figs. 17 and 19*a* show one inch between the upper edge of the rubber models and a line joining the center of the pin centers, or an eccentricity of 1⅞ in., the upper edge of the short tie bar is approximately on the pin center line, equivalent to an eccentricity of ⅞ in., while the upper edge of the rubber at the center line of the long bar is 0.4 in. above a line joining the pin centers, an eccentricity slightly less than ½ in. With the greater load of Fig. 19*c* the rubber tie bars show a still greater deformation.

In order to investigate the effect upon the stress distribution in sections of irregular shape when subjected to a bending load, the irregular shaped section shown in Fig. 18 was cut from a special grade of rubber ¼ in. thick and ruled up in the unstrained condition as previously described. The ruled up section is shown, mounted upon a board, in Fig. 20*a*.

For the first experiment, the load was applied to the long straight edge so as to put the material along this edge under compression and the material in the opposite or irregular edge in tension. This arrangement is illustrated in Fig. 20*b*, the tacks being placed after the load was applied to prevent the rubber from buckling. The photograph clearly indicates that practically no deformation took place along the upper edge of the one-inch by two-inch projection, whereas the stress at the corners where this projection joined the main body was unduly severe.

For the second experiment, the load was applied at the upper edge of the projection. The stress action along this edge and at the corners was somewhat similar to that obtained above and is indicated in Fig. 20*c*.

It will be noticed that on a line through the projecting part, paralleling the uniform section, in the first test the rubber is in tension, and in the second test the ruled lines show a compression, the maximum stress in each case being on a continuous line, that is, on a line common to the upper and lower rectangles, and not at the outermost edge, as might be supposed. In fact if the width of the upper two-inch edge in Fig. 20*b* is calipered and compared with the corresponding edges of Figs. 20*b* and 20*c*, it will be found that very little change in length has taken place due to bending.

No doubt the reader in reviewing the elastic action of the rubber specimens, as illustrated, will question the validity of the test results, or their inconsistency with the usual theoretical formulae. It should be remembered that the usual formulae relative to the strength of materials apply only to such members as plain bars, etc., having a uniform and continuous cross-section and not to members having an irregular contour or whose cross-section increases or decreases suddenly.

In writing this article on the effect of abrupt changes of section on the resistance of materials it has been the aim of the writers to recapitulate available data and in addition thereto, by means of the rubber test specimens, assist the designer in visualizing its practical application.

TUBE SPACING TO SUIT BAD WATER CONDITIONS

BY C. E. BROOKS
Superintendent Motive Power, Grand Trunk Pacific

One of the greatest sources of trouble to railroad men operating in bad water territory without a doubt is tube leakage. By bad water conditions is meant waters which carry from 50 to 300 grains of impurities per one-thousand U. S. gallons. A typical analysis is as follows:

	Grains per U. S. gallon
Silica	.974
Oxide of iron	.128
Carbonate of lime	Trace
Sulphate of lime	56.391
Carbonate of magnesia	19.378
Sulphate of magnesia	7.007
Sodium and pot. sulphate	26.562
Sodium and pot. chloride	1.700
	112.140

It is a well known fact that often a locomotive does fairly well as far as steaming qualities are concerned, until shopped, with flues so badly scaled and mudded up that they have little if any conductance; in fact, many cases are found where the flues are simply smoke conveyors, and take but very little part in the action of the boiler. The remarkable feature is, that if firebox sheets are in good condition steaming qualities are much less affected than one would expect.

I believe this can be attributed almost entirely to the present systems of tube spacing, which I consider have these two general defects:

(1)—Impeding the circulation of water about the flues by forcing the globules of steam formed on the flues to work through a zig-zag course, thereby
  (a)—delaying steam generation, and
  (b)—forming a much greater insulating coat of steam over the tubes, resulting in loss of heating surface.

(2)—Facilitating the blocking up with scale due to the impossibility of loosened scale or mud working its way through to the belly of the boiler, the general result being blocking up of water spaces with mud and impeding circulation thereby.

The remedy for this appears to be: First, the use of a much larger diameter flue than present practice calls for below the superheater flues; second, spacing these tubes in vertical and horizontal rows, with the maximum reasonable spacing; third, eliminating all small tubes between the superheater flues.

The object of the use of larger tubes is to reduce the resistance of the gases and, combined with the vertical and horizontal spacing, to give the generated steam globules the shortest and easiest path to the surface of the water and permit loosened scale to drop to the belly of the boiler.

No doubt these recommendations will meet with criticisms from many sources, the chief of which will be loss of heating surface and poor staying of sheets. The answers to these objections are that the heating surface is of little value if not covered with water, and that in order to get a maximum so-called tube heating surface important principles of conductance and circulation have been sacrificed by designing the tube spacing to effect a maximum resistance to both.

As far as staying is concerned, it should be recalled that in bad water districts where a set of tubes, properly applied, may leak the first trip over the road, 90 per cent of the leakage occurs in a part of the sheet which is well stayed, namely, towards the center of the small tube area. This is due, not to the fact that too much stress is exerted on the bead of the flue, because in that case we would get the same results with good water. It is due to the fact that when certain combinations of impurities exist in the boiler steam pockets are formed where the circulation is poor, thereby resulting in overheating the beads, with the resultant expansion and contraction, which finally causes a leak. The only real remedy for this is circulation, which can be improved by a re-design of the vertical passages between the tubes.

Railroad Administration News

Status of Shop Crafts; Wage Case; Summary of Fuel Conservation Results; Report of Safety Section

Practically all of the locomotives that have been used during the past year on railroads other than those of their owners, in accordance with the Railroad Administration's plan of pooling facilities, are now being returned to their home roads or are in repair shops on their way home. Instructions were issued about March 1 that when leased locomotives could be returned to their owning roads without inconvenience and without serious interruption to traffic it should be done, as a large number of the roads at that time had locomotives of their own in storage. Nearly 800 locomotives at that time were being operated under lease by roads other than their owners. They have been repaired and put in good shape before returning at the shops where the work could be most conveniently done. In many cases, particularly where locomotives were returned from eastern or southern roads to the western lines, it was necessary to use very roundabout routes because of insufficient clearance.

Status of Shop Craft Wage Case

In reply to many inquiries from its members "relative to the delay in the settlement of wage increases" asked of the director general by the shop craft organizations on January 7, the Railway Employees' Department of the American Federation of Labor has explained that after having presented its arguments to the wage board on March 12, 13 and 14, its committee was notified that the representatives of the regional directors were not prepared to present their side of the matter, and the hearing was postponed by the board till April 14. The employees committee protested vigorously against this delay, but the board declined to alter its decision. This case is being presented by 14 representatives of the employees, with B. M. Jewell, acting president of the Railway Employees' Department, as chairman, and 14 representatives of the regional directors, with C. E. Chambers, mechanical assistant to the regional director for the Allegheny region, as chairman.

On April 15 Mr. Chambers testified before the Board of Wages and Working Conditions at Washington, and asked the board to deny the increases in wages and allowances asked by the federated shop crafts affiliated with the American Federation of Labor, on the ground that their wages are now higher than those paid generally by industrial concerns not under government control. The rates asked by the shop crafts include a basic rate of 85 cents an hour for experienced mechanics in place of the present rate of 68 cents, 60 cents for helpers, and also differentials for certain classes of employees, 30 days' holiday a year and other concessions in time. These increases, Mr. Chambers said, amount to 25 per cent in the basic rate, 46 per cent for second class electrical workers now paid 58 cents, 35 per cent for car men now paid 63 cents and 46 per cent for those now paid 58 cents.

He presented a set of exhibits comparing the rates of wages paid to railroad shop crafts with minimum, maximum, going and average hourly rates paid to employees performing similar work in 1,293 industrial plants. Ship yards and similar plants were not included, he said, because of the emergency character of the work. The information was received in reply to questionnaires, all of which have not yet been answered, so that the information is not entirely complete. The exhibits showed average hourly rates in the outside industries as follows: Machinists, 56.2 cents; boilermakers, 62.6 cents; blacksmiths, 58.4 cents; sheet metal workers, 54.7 cents; first class electrical workers, 55.8 cents; second class electrical workers, 46.3 cents; car men, 48.2 cents; molders, 60.6 cents, and helpers, 44.3 cents. The majority of the outside machinists receive rates of 50 cents and upward, while the prevailing rate for helpers is 45 cents. Mr. Chambers said that the pay rolls had also been increased by the classification of work made in Supplement No. 4 to General Order No. 27, because the first class rates are now paid in many instances for work formerly performed by helpers at a lower rate, as the craftsman rate is now paid for some of the work performed by men not fully qualified as craftsmen. Formerly a craftsman engaged in piece work made his helper do all he could, whereas now in the intervals between work assigned to the helpers, the helper frequently does nothing. Mr. Chambers also presented exhibits showing the labor turnover, which he said now is about 50 per cent less than it was during the first half of 1918; in other words, it has been reduced to about normal.

A. O. Wharton, vice-chairman of the board, questioned the completeness of the figures because they did not include many industries on the Pacific Coast where high rates have been established, or in the inter-mountain territory, where he said he knew that many mechanics were receiving a minimum of $1 an hour. He also commented on the absence of figures from the Ford Motor Company, which he said had recently established a minimum of $6 a day for mechanics. Mr. Chambers said that many of the questionnaires from the more remote points had not yet been received, and that the committee had been unable to obtain the figures from the Ford plant. He remarked that the $6 minimum was 75 cents an hour.

BACK PAY FOR SHORT LINE EMPLOYEES

Director General Hines has recently announced a decision that employees of the short line railroads which were not taken under federal control because of the general counsel of the Railroad Administration ruled that they were not "systems of transportation," are not entitled to back pay under General Order No. 27, and that employees of railroads relinquished and subsequently taken under federal control are not entitled to back pay for the period back of the date of the contracts subsequently executed. As to the employees who might have been induced to subscribe for Liberty bonds by the appeal sent to all railroad men early last year by Director General McAdoo, calling attention to the fact that they were about to receive increases in wages and back pay, Mr. Hines says that unfortunately these assurances were not restricted, as they ought to have been, to employees of railroads operated by the government, but that there was no intent to mislead any employees, and that those who bought Liberty bonds on the strength of such assurances have only done what every class of citizenship was urged to do; and have made a splendid investment unless they have lost because it became necessary to sell the bonds at a discount.

These conclusions, adhering to the position formerly taken by Mr. McAdoo, were expressed by Mr. Hines in a letter to the chief executives of the organizations representing railway employees, who had asked for back pay for the short line employees back to January 1, 1918.

ECONOMY IN CONSUMPTION OF COAL IN 1918

Good results attained in 1918 as a result of the campaign for fuel economy are shown in a compilation prepared by the Fuel Conservation Section of the Railroad Administration comparing some of the principal statistics relating to the consumption of coal for 1916, 1917 and 1918. The tons of coal consumed in freight service in 1918 amounted to 86,634,345 as compared with 79,454,966 in 1916 and 86,795,339 in 1917, but the pounds of coal per 1,000 gross ton miles show a decrease in 1918 as compared with 1917, although an increase compared with 1916. The amount was 199.7 in 1918, 200.9 in 1917 and 192.1 in 1916. In passenger service the tons of coal consumed in 1918 amounted to 30,570,030 as compared with 32,583,171 in 1817 and 30,494,233 in 1916. The pounds of coal per passenger train car mile used in 1918 averaged 19.3 as compared with 19.4 in 1917 and 18.5 in 1916. In the last six months of 1918 the pounds of coal per 1,000 gross ton miles were only 190.7 as compared with 201.8 in 1917, a decrease of 5.5 per cent, and the pounds per passenger car mile were 18.2 as compared with 18.8, a decrease of 3.2 per cent.

The report also compares the average cost of coal per ton in December, 1918, and December, 1917. The figures for some of the principal roads, which do not include the cost of the haul on the user's rails, are as follows:

Road	December, 1918	December, 1917
New York, New Haven & Hartford	5.78	5.25
Delaware & Hudson	3.99	3.61
Boston & Maine	6.21	5.44
Erie	3.49	3.77
Lehigh Valley	3.62	3.06
Michigan Central	3.78	3.63
New York Central	3.43	3.07
Baltimore & Ohio—Eastern Lines	2.66	2.30
Baltimore & Ohio—Western Lines	2.65	2.30
Pennsylvania Eastern Lines	2.88	2.48
Pennsylvania Western Lines	2.76	2.48
Philadelphia & Reading	3.75	3.51
Atlantic Coast Line	4.25	4.00
Louisville & Nashville	3.13	2.15
Southern	3.48	2.68
Chicago & North Western	3.01	2.19
Chicago, Milwaukee & St. Paul	3.42	2.87
Atchison, Topeka & Santa Fe	3.53	2.97
Southern Pacific	6.02	6.72
Union Pacific	2.77	2.48
Missouri Pacific	3.09	2.51
St. Louis-San Francisco	3.32	2 69

ARRANGEMENTS FOR EQUIPMENT FINANCING

Arrangements have been completed for temporarily financing the amounts now due the car and locomotive builders by the Railroad Administration, amounting to approximately $40,000,000, by the issuance of certificates of indebtedness, bearing interest at five per cent, which may be used as collateral for loans from the banks or possibly from the War Finance Corporation, but up to April 9 the certificates had not actually been issued. Some of the certificates, which are to be in convenient denominations for that purpose, will be passed by the equipment companies to the sub-contractors who furnished materials and specialties, but whose contracts are with the builders rather than with the government. For this reason the specialty people were not admitted to the conferences between the builders and the Railroad Administration representatives, but conferences between the sub-contractors and builders were held afterward. Some of the specialty men were inclined to insist on being paid in cash rather than certificates, but it is stated that if they insist on cash they will have to wait until it is available, as the companies to whom the certificates are issued will have to give their own notes to the banks and might thus be left "holding the bag" for a time in case of unexpected delay to the railroad appropriation.

Whatever interest above five per cent is charged by the banks will be reimbursed by the government.

A sub-committee was appointed to represent the equipment companies at Washington in connection with the issuance of the certificates, consisting of George Shaw, Standard Steel Car Company; H. W. Wolf, American Car & Foundry Company; L. O. Cameron, Pressed Steel Car Company, and F. O. Riener, Haskell & Barker Car Company. Companies having contracts with the builders were requested to telegraph their bills as of April 1 to J. M. Hansen, secretary of the car and locomotive manufacturing committee, at Washington.

REPORT OF SAFETY SECTION

The Railroad Administration has issued a notice regarding a report of the Safety Section, stating that since the government took control of the transportation facilities its record is one of which both employers and employees should have cause to feel proud. The statement indicates, however, that a similar pride is not felt in the activities of the railroad safety departments before that time. On January 1, 1919, there were 20,156 railroad men serving on railroad safety committees under the direct supervision of the Safety Section "actively working for safety on the railroads; whereas a year ago there were comparatively few men thus employed." It is also stated that on certain typical roads, where, in the month of January, 1918, there were in the aggregate 212 persons killed, and 3,118 were injured, the record for the same month in 1919 shows the number killed as 94, and of injured 363. Apparently it is not the province of the Safety Section to note any difference in operating conditions in the two months.

Concerning the campaign directed to cleaning up yards and rights of way, one of the big roads reports:

"One division has picked up between 675 and 700 carloads of scrap and debris; and 92 cars of scrap iron were gathered along rights of way in yards. On the divisions that were cleaned up through the efforts of the safety department a number of old link and pin couplers were picked up, a proof that no clean up had been made for a number of years." One of the circulars issued by the brotherhood lodges reads: "We feel the safety movement is of the utmost importance to all employees and your hearty co-operation and earnest support is requested, that accidents and personal injuries to our fellow employees may be reduced to the lowest minimum." The Safety Section is planning a "No Accident Month" for May in the Southwestern Region.

CONTINGENT FEE COVENANT MODIFIED

Director General Hines has announced that, with the approval of Attorney General A. Mitchell Palmer, he has consented to a modification of the covenant inserted in purchase contracts under the direction of the Department of Justice issued June 18, 1918, prohibiting the payment to agents of fees contingent upon the procuring of contracts with the government in so far as it relates to railroad contracts.

Since this order was promulgated by the attorney general, there has been a good deal of complaint from railway supply houses that its provisions were working a hardship upon them, and that the government itself was losing the benefits of a system which, previously, had proved both economical and satisfactory in every particular.

Hereafter, the attorney general's order will not affect contracts made between the Railroad Administration and supply houses which, previous to government control, carried on their business through bona fide selling agencies.

At the suggestion of John Barton Payne, general counsel for the Railroad Administration, the following clause will be inserted in appropriate cases in future railroad contracts:

"Provided, however, that this covenant shall not invalidate a contract obtained through a bona fide commercial representative employed under a general contract covering designated territory and shall not prohibit or penalize the employment of the same agencies, rates and methods of compensation in dealing with the United States heretofore customarily employed by the contractor in the regular course of his business in similar dealings with the railroad corporations."

ORDERS OF THE REGIONAL DIRECTORS

Payment of Employees on Hourly Basis Instead of Piece Work Basis.—The Southern regional director has issued the following:

"Referring to my telegram E-64, January 2, 1919, repeating message from the director general of railroads, dated Washington, December 31, regarding preference of shopmen throughout the country to be paid on hourly basis, as provided in Supplement No. 4 to General Order No. 27, rather than the piece work basis in effect on many railroads.

"Acting under the permission of the director general, granted by his message December 31, 1918, employees on many railroads have indicated their preference with respect to working upon an hourly instead of a piece work basis. Director Tyler, Division of Operation, Washington, writes me he is advised that at some shops, after a decision has been reached in this way, certain local officers or foremen are continuing to agitate the matter, urging upon the men that another vote be taken, with the result that in some cases two or three votes have already been taken upon the subject.

"This is taken as indicating a purpose on the part of those local officers to circumvent the wishes of the director general, so clearly expressed in his telegram of December 31. The effect is to keep the shop organizations at such points continually agitated with most certain detrimental effect upon the efficiency and morale of the organization.

"Will you please direct that on railroads under your jurisdiction where employees have once decided this matter by vote, it will be considered as definitely settled during the period of federal control."

Repairs of Short Line Cars.—The regional director, Eastern region, by circular 500-14-5A669, announces that beginning with April 1 bills for repairs to cars and engines belonging to non-federal roads—the "short lines"—are to be made on the basis of actual cost of labor and materials, plus 15 per cent, with 10 per cent added to the total to cover superintendence and accounting. Material furnished by the road owning the car or locomotive is to be billed to the road making the repairs, which, in turn, should re-bill it at the same rate plus 15 per cent for handling. Proper credit is to be allowed for scrap at current prices.

Reclamation of Scrap.—The regional director, Eastern region, by circular 2900-99A-670 calls attention to carelessness in the gathering and sale of scrap material. Scrap material has been sold without assortment, and new articles, available for immediate use, have been sold as scrap. Federal managers are called upon to review the instructions and regulations now existing in order to make sure that the greatest possible care is exercised, and to take any action that may be found necessary to insure that the sorting, reclamation and sale of the scrap is being properly and economically handled.

Use of Lock Nuts and Grip Unit Nuts on Boilers.—Order 186 of the Southwestern regional director calls attention to the fact that lock nuts and grip unit nuts are being used on studs which are screwed into boilers, and instructs that hereafter lock nuts and grip unit nuts must not be used in this manner, and that where a lock nut is required a jam nut is to be used.

Brakes on U. S. R. A. Hopper and Gondola Cars.—Order 194 of the Southwestern regional director requires inspectors to make a special inspection of all United States composite gondola standard and hopper cars, and that where these cars are found without sheave wheels on the brake shaft end of the hand brake rod to send these cars to shop, regardless of ownership, and have the brake arrangement changed to conform to the approved standard.

Use of Headlight Generators.—Circular 203 of the Southwestern regional director reminds enginemen that by keeping water gages and shields clean or by slightly relocating the lamps of these water gages, it will not be necessary to run headlight generators during daylight as is now being done in many cases.

Reports of Air Brakes Cleaned.—The Eastern regional director by Order 1801-131A691, calls for regular monthly reports, beginning with April, showing the number of freight car air brakes overhauled, with a statement showing the ratio of number cleaned to number of freight cars owned.

IRON THAT CAN BE WHITTLED.—It is well known that rapid cooling of hot metals hardens them. That the opposite is true has recently been demonstrated in striking fashion by the General Electric Company. One of their scientists annealed American ingot iron surrounded by hydrogen gas for three hours at a temperature above 1,600 deg. F. The product was very little harder than the softest copper, and can be whittled with a knife.

CAR DEPARTMENT

STORAGE BATTERY CARS FOR USE IN YUCATAN

The three cars shown in the illustrations have just been delivered to the United Railways of Yucatan by the Railway Storage Battery Car Company, New York. The cars are driven by motors geared to the axles and power is supplied to the motors by Edison storage batteries. The cars are designed to be operated either singly or in trains by multiple unit control.

The schedule as laid out for service to be performed covers the run from Merida to Progreso, a distance of 23.6 miles. There are six stops between terminals and the running time over the line is 45 minutes. The city of Merida has a population of 70,000, while that of Progreso is 8,000. The grade between the two cities is practically level and the total service per day is three round trips. The cars are fitted for passenger service and are able to draw a trailer carrying baggage and express matter.

Three Storage Battery Cars Recently Shipped to the United Railways of Yucatan

CONSTRUCTION

The car is constructed according to M. C. B. standards and the car body and its appliances are all steel with the exception of doors and inside fittings. The over-all length of car body is 56 ft., the extreme width is 8 ft. 6 in., and the extreme height is 12 ft. Reversible seats upholstered with rattan are used and the seating capacity of the car is 66 persons.

The underframe is built up of two 6-in., 10.5-lb. channel center sills spaced 13¼ in. back to back, with side and end sills of 10-in., 15-lb. channel sections. The transoms are built up of flat plate; the top or tension member is 9 in. wide by 7 in. in thickness, while the bottom member is 9 in. wide by 1 in. in thickness. In addition to the end sills the underframe includes a curved buffer beam of 5-in. by 5-in. by ½-in. angle section curved to a radius of 18 ft. ¾ in. The cross members of the underframe are 6-in., 8-lb. channels and are five in number.

The body frame is of light steel construction, the posts being 2-in. by 2-in. by ¼-in. T-sections, sheathed below the windows with 3/32-in. steel plate. The side plates are 2½-in. by 2½-in. by ¼-in. angles. The carlines are of sections similar to the posts and they extend across the car from side plate to side plate.

The cars are fitted with M. C. B. couplers and single spring draft gears.

Brill 69E trucks are used. These trucks have a 5-ft. 6-in. wheel base and are spaced 14 ft. between centers. They are of the arch bar type, are light, each weighing 6,220 lb. without motors, and are fitted with M. C. B. wheels and axles. Roller bearing journal boxes are used.

The total weight of car without load is 56,600 lb.; the batteries alone weigh 12,600 lb., and the total weight of the motors and control equipment is about 6,000 lb. This makes a total weight per passenger, on the basis of the seating capacity, of about 500 lb.

MOTOR AND CONTROL EQUIPMENT

Each car is equipped with four General Electric, No. 261, 250-volt, direct current motors. There is one motor for each axle and each motor is connected to the axle with a single reduction gear. These motors were supplied to meet the requirements of supplying a single car with 88 mechanical horse-power during acceleration and 28 mechanical horse-power when running free and to supply a car and trailer with 166 mechanical horse-power during acceleration and with 39 mechanical horse-power when running free. The motors are protected by Condit instantaneous, automatic, overload circuit breakers.

The electrical equipment includes double end multiple unit control and the cars are connected with a seven-point cable when they are used in multiple units. The cars are equipped with General Electric straight and automatic air brakes.

BATTERY

Each car is equipped with a battery of 248 Edison type A-12 cells; 240 of these cells are used for the power circuit and eight for the lighting circuit. While the battery is being charged all of the cells are connected in series. A Sangamo ampere hour meter is installed in the charging circuit to insure the batteries the proper amount of charge and to protect them from overcharge.

PERFORMANCE

These cars are capable of developing a speed of 45 miles an hour on level tangent track. It is possible for them to negotiate grades of from 8 to 10 per cent and to haul loads of from 30 to 35 tons at a fair maximum speed. They may also be used to spot and drill loads up to 150 tons. Under ordinary service conditions their range of operation on one charge of the battery is about 120 miles, although this range will seldom be required in branch line service.

The particular advantage of this type of car as presented by the maker lies principally in the characteristic of the alkaline storage battery. As the battery is comparatively light in weight, the total weight of the car is not excessive and as the battery is strongly built and not affected by ordinary vibration and shock it lends itself particularly to this class of service. The only attention required for this class of storage battery is to keep it charged and filled with water.

Interior of the Storage Battery Car for Yucatan Showing the Seating Arrangement

For branch line steam railroad service cars of this type have the advantage of requiring little attention which cannot be given by the regular passenger car maintenance forces. Aside from the batteries the only other special equipment are the motors and control apparatus, which need little attention except at general overhaul periods.

A storage battery, of course, represents a loss of efficiency, but it does away with line losses, as compared with a trolley system, and where 24-hour service is not required the cost of keeping power on the line with no cars running is eliminated. Furthermore, it is usually possible to charge batteries during an off-peak period and thereby obtain a lower charging rate.

Similar cars are in use on the Cambria & Indiana, the Lorain, Ashland & Southern, the Atlanta, Birmingham & Atlantic, the Chattahoochee Valley, the Long Island and the Pennsylvania. During the mechanical conventions to be held at Atlantic City next June a demonstration car of this type will be in operation between Atlantic City and Ocean City.

The Car Bodies and Their Appliances Are All Steel, Except for the Doors and Inside Finish

STANDARD FREIGHT CARS ARE HELD IN STORAGE

Since the signing of the armistice, in addition to the large number of idle cars which have been in service, several thousand of the new standard cars built on the orders placed by the Railroad Administration last year have been completed by the builders, but cannot be stencilled because the railroad companies, which are expected to take them and pay for them, have not yet accepted them. Over 26,000 of the 100,000 standard cars ordered had been accepted by the roads to March 31, according to a statement compiled by the Railroad Administration, but this does not account for at least 10,000 more than have been built, and are being held in storage until it can be ascertained whether the Railroad Administration can force the companies to take them at the high prices. The administration takes the position that it can, because they were ordered under war conditions and allocated to the various roads, but many of the companies are not in a position to finance them, and meanwhile the Railroad Administration is paying for them at the contract price minus an amount to cover the cost of stenciling. The standard locomotives, on the other hand, are being accepted as fast as they are turned out.

Draft Gear Test Plant of the T. H. Symington Company

Draft Gear Test Demonstrations

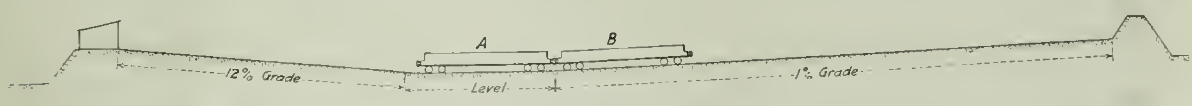
Method of Recording Action Under Impact Between Cars Devised by Inspection and Test Section

On April 10 and 11 a series of public demonstrations were conducted by the Inspection and Test Section of the Division of Operation, United States Railroad Administration, at the draft gear testing plant of the T. H. Symington Company, Rochester, N. Y. The manufacturers of draft gears, the draft gear committee of the mechanical section of the American Railroad Association, the mechanical committee of the Railroad Administration and a number of railroad officers were present. The purpose of the demonstration was to disclose in advance of a series of official draft gear tests to be conducted at this plant, the methods of testing which will be followed, and particularly to demonstrate the operation of the devices which have been developed to graphically record the action of the draft gear between two cars, one moving and the other standing at the instant of impact.

For a period of several months the Inspection and Test Section has been engaged in testing draft gears under the direction of B. W. Kadel, assistant engineer, the program including tests both with the static machine and under the drop, and the work to be performed on the Symington plant constitutes the next series of tests in the draft gear program, in all of which the draft gear committee of the Master Car Builders' Association is co-operating.

The test plant of the T. H. Symington Company was built to facilitate the testing of draft gears under as nearly as possible actual service conditions. It consists of a test track, one end of which is laid out on a 12 per cent grade for accelerating purposes, followed by a section of level track at the other end of which is a one per cent ascending grade. Two 50-ton steel frame gondola cars with wood floors and siding are used in the tests. The facilities for handling the cars consist of a motor driven drum hoist housed at the top of the 12 per cent grade, the cable from which is attached to a special puller car to which the test car is attached in such a way that the coupling may be tripped at any predetermined point on the grade; a motor driven capstan winch beside the track is used to spot the cars on the level track.

Both of the 50-ton gondola cars are loaded so that each has a gross weight of 143,000 lb. The adjoining ends are arranged so that they may be equipped with any draft gear of standard dimensions, or with solid buffers. The moving car, designated as the *A* car, is drawn up the inclined track and released at stations predetermined to produce whatever velocity of impact is desired. The stationary car, designated as the *B* car, is placed at a fixed point on the track so that the performance of the cars during the period of impact is comparable for all tests. This position is chosen so that the *B* car stands fully on the 1 per cent decelerating grade when struck by the *A* car, while the latter moves upon level track during the period of impact and for a distance of approximately six feet before the instant at which the buffing faces of the two drawheads come in contact. The cars are equipped with flat face buffing stems instead of standard couplers in order to produce a normal impact without coupling the cars.



Profile of the Test Track

The method of recording and comparing the action of various draft gears under impact between the two cars is a development recently worked out by the Inspection and Test Section and the engineers of the T. H. Symington Company, working together.

The outstanding feature of the new recording apparatus is that a direct and continuous record is made of the movement of both cars during a period beginning before the instant of impact and continuing after the final separation of the two cars. The records of the car movements are made by pencils traveling in a line parallel to the track and marking upon revolving drums, one for each car, both of which are mounted on a common shaft also parallel to the track. The drum shaft is worm driven by a 32-volt shunt-wound, direct-current motor, which receives its power from a storage battery. The paper speed of the drum is approximately 31 in. per second. The pencil holders for the two drums are mounted on guides parallel to the axis of the drums and are moved by bars which project out from the sides of the cars. Provision is made for horizontal movement of these bars at right angles to the longitudinal center line of the car. Guides attached to the instrument base engage a lever suitably attached to each bar to withdraw it from contact with the pencil holder before it can be moved beyond either end of the cylinder.

The line drawn upon the first or *A* drum shows the exact velocity of the *A* car at the moment of impact, denotes the exact point of impact, shows by the type of curve drawn the rate of retardation of this car and finally gives the velocity of the car after the two cars have parted. The line drawn upon the *B* drum shows the rate of acceleration of the *B* car and shows the final velocity of this car as the two cars part. Curves made in the same test upon the *A* and *B* drums are reproduced in Figs. 1 and 2, respectively.

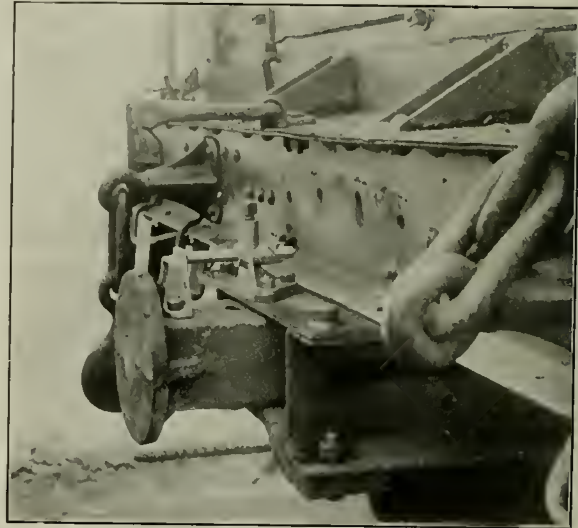
When a test is to be made the two cars are spotted with the buffing faces in contact and all slack eliminated from draft gears and attachments. With the drums standing, the pencil carriages are given a slight movement along the guides to draw common reference lines, 3-3, Fig. 1, and 4-4, Fig. 2, by means of which the two cards later may be synchronized as to time. The pencils are then set on both drums in the positions which they will occupy against the bars projecting out from the sides of the cars at the instant the buffing faces between the two cars come in contact.

With the pencil carriers thus located the drums are rotated to draw the common datum line, 1-1, Fig. 1, and 2-2, Fig. 2, upon these drums. Line 2-2 on the *B* drum indicates the standing position of the *B* car; line 1-1 on the *A* drum indicates the position of the *A* car at the first instant of contact with the *B* car. By means of these datum lines the cards for the two cars can be matched as to their positions along the track.

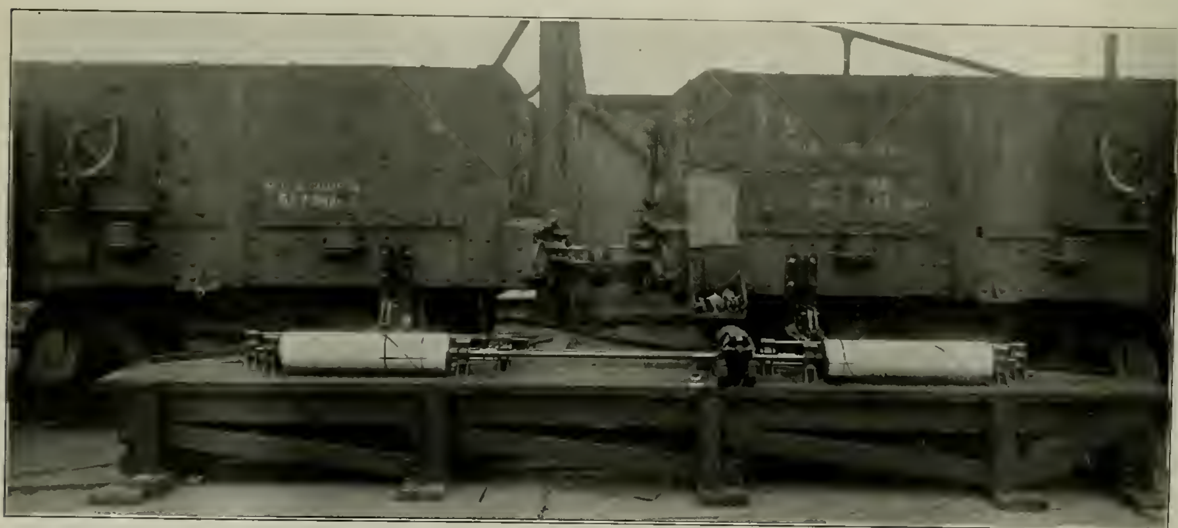
The test is then run by hauling the *A* car up the 12 per cent grade, releasing it at the point required to produce the desired velocity of impact, the pencil on the *A* drum being moved back from its impact position so that a record of the velocity of the car as it approaches the point of impact may be obtained.

From the curves a study can be made of the car movements throughout the cycle of draft gear movement and the velocity of the *A* car at the moment of impact can be accurately determined, as well as the velocities of both cars beyond the point of separation. Thus on the card for the *A* car, Fig. 1, the angularity of the line below the datum line denotes the exact velocity of the striking car, and the weight being known, its energy as a moving body can be accurately determined.

Referring again to Fig. 1, at point 5 it is known that the *A* car first met the *B* car, that the draft gears started to close



The Flat Face Buffer and Travel Gage



The Instrument on Which the Car Movements are Recorded on a Time-Distance Basis and consequently that its velocity began to decrease. Assuming that the draft gear action is entirely smooth and that the bombardments of static testing are not present in this service, it is possible to determine from the shape of the

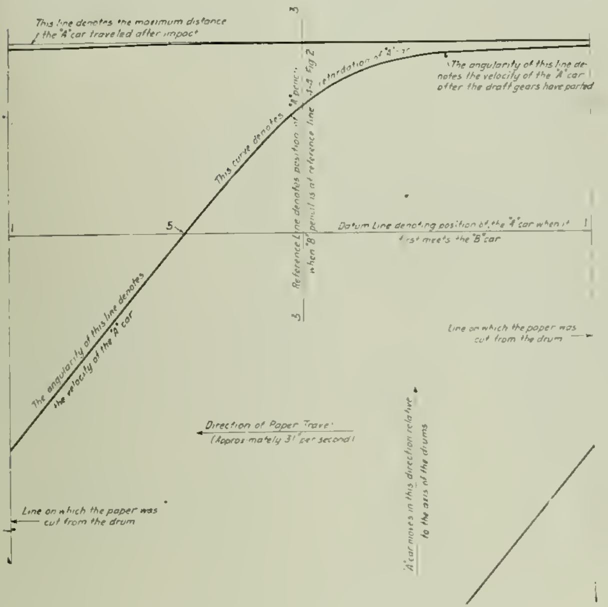


Fig. 1—Card Made by the A Car

curved line denoting the decrease in velocity of this car, the approximate forces which must have been at work to produce the retardation shown between any two points on the time

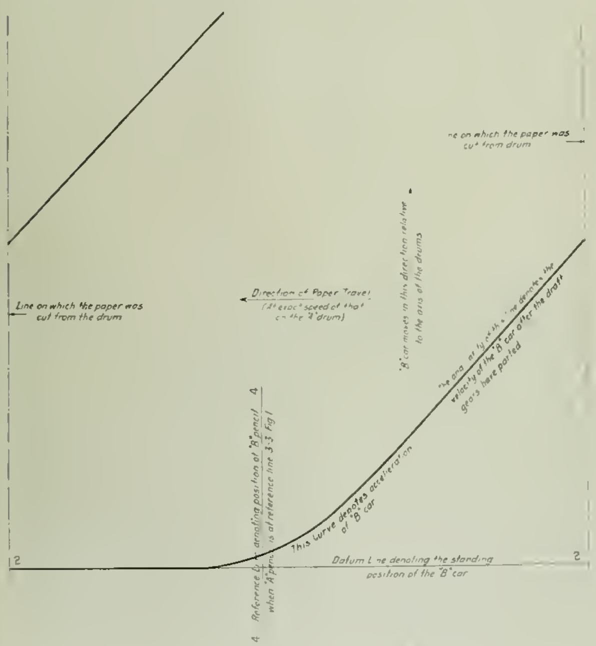


Fig. 2—Card Made by the B Car

axis. From the final angularity of the approximately straight line beyond the point of separation of the two cars can be determined the velocity of the *A* car after the draft gears have parted and the number of foot pounds of energy still stored in this car. On cards made from certain draft gears the *A* car comes to rest as denoted in Fig. 1 before it has traveled beyond the limit of the pencil movement along the *A* drum.

Referring to Fig. 2, from the curve drawn by the *B* car can be determined the rate of acceleration of this car and its final velocity when the cars part. Knowing this velocity and the weight of the car it is possible to calculate the energy transferred from the *A* car to the *B* car. From Figs. 1 and 2 it is thus possible to determine the actual energy absorption which has taken place during the draft-gear cycle.

The common datum and reference lines drawn on the two cards prior to the test run make it possible exactly to superimpose one curve upon the other, thus producing a graphic record of the relationship of the cars to each other throughout the significant range of movement. This has been done in Fig. 3.

From the superimposed cards it is possible to determine point 5 at which the draft gears begin to close, the point at which they closed to the maximum amount, point 6 at which they finally part, the distance the cars move along the track during any period of time within the range of the diagram, the time required for any phase of the gear movement cycle, and the amount of draft gear travel at any instant, this being

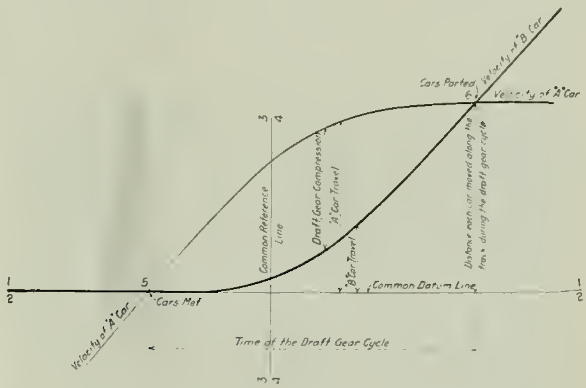


Fig. 3—Cards from A and B Cars Superimposed

indicated by the vertical distance between the two curves at that instant.

In addition to the instrument with which these diagrams are obtained, the *B* car is also equipped with a small constant-speed motor driven recording drum, the pencil movement of which records the movement of the buffer stem on that car with relation to the car body, by means of an equalized piano wire connection to the top and bottom of the rear end of the front follower. The card from this drum reflects the smoothness of action of the draft gear in closure and release on a time-closure basis and provides a measure of the maximum closure of the draft gear on the *B* car. In addition to the record thus obtained, which compensates for any tendency of the follower to tilt in a vertical plane, the buffers of both cars are fitted with the closure gage shown in one of the illustrations, from which the maximum gear movement may be measured. These gages are a part of the regular equipment of the test cars as they have previously been used.

To the side of each car are also attached two pendulum shift gages or seismographs. The pendulums of these instruments are arranged to swing freely in but one direction from the perpendicular, the two instruments on the same car being arranged so that the pendulums swing in the opposite directions. The swing of the pendulums under the action of inertia carries with it a small marker mounted on a graduated segment, a friction spring in the marker causing it to remain in the position to which it is moved by the swing of the pendulum. These instruments are a part of the regular test equipment of the cars and the records obtained from them provide a means of comparison of the load shifting tendencies of the impact with various draft gears.

The demonstrations were entirely unofficial in character, no records or detail comparisons of commercial gears being taken. The curves here reproduced were obtained with M.C.B. spring draft gears in both cars.

A SUPPLY TRUCK FOR EMERGENCY REPAIRS

BY A. J. KIPP
Shop Engineer, Chicago, Milwaukee, & St. Paul

A station supply truck fitted with all the material for emergency repairs which is usually carried in supply sheds, is a new device that has proved very useful since its introduction on the Chicago, Milwaukee & St. Paul. These trucks are designed to be used at passenger terminals and are a great help in making quick repairs. Formerly if a train came in with a hot box the inspector had to go to the shed for jacks, brasses and packing, but now the truck is brought up beside the car and the man has all the tools and supplies he requires within easy reach. For other minor repairs the truck has been found equally convenient.

The truck itself is 5 ft. 2 in. long, 3 ft. 8 in. high and 14 in. wide, with three horizontal doors on each side extending the full length of the truck. The arrangement was made as compact and narrow as possible so that the truck could readily be used between two trains standing on adjacent tracks. The interior is partitioned off for holding the standard supplies carried in the truck, which are listed below.

The Supply Truck Facilitates Making Quick Repairs

2—Journal box jacks.
2—Journal box jack boards.
2—Journal box jack levers (pinch bars).
2—Packing hooks.
2—Packing irons.
1—Pail prepared packing.
1—Empty packing pail.
6—Brake shoe keys.
3—Brake shoes.
Spring cotters (various sizes).
1—Brass 5½ in. by 10 in.
1—Brass 5 in. by 9 in.
1—Brass 4¼ in. by 8 in.
2—Brake connection pins 1⅛ in.
2—Brake connection pins 1¼ in.
2—Brake connection pins 1⅜ in.
1—Knuckle pin, cotter and washer.
1—Bearing wedge 5½ in. by 10 in.
1—Bearing wedge 5 in. by 9 in.
1—Bearing wedge 4¼ in. by 8 in.
12—Standard nuts each, ⅞ in., ¾ in., ⅝ in.
12—Lock nuts each, ⅞ in., ¾ in., ⅝ in.
1—Steam and air hose wrench.
1—12-in. pipe wrench.
2—1¼-in. train pipe nipples and couplings.
3—Each, ¾-in. and 1-in. train pipe nipples and couplings.
3—Combination air and signal hose couplings.
1—Small roll ⅛-in. wire.
6—Air brake defect cards.
1—Signal hose.
3—Air hose.
3—Steam hose.
1—1¼-in. angle cock complete.
6—Steam hose gaskets.
6—Air hose gaskets.
2—Signal hose gaskets.
1—Cold chisel.
1—Hammer.
1—Small drill.
1—Bracket for blue flag marker.
1—Bracket for blue lantern.
1—Screw driver.
1—Gallon can of car oil.
6—Wooden oil box lids (various sizes).
6—Pieces of second hand carpet to use as box covers.
4—Bolts ½ in. by 6 in.—3-in. thread with nut and washer and lock nut.
12—Tee head pedestal tie strap bolts with nuts and washers.
1—Coupler tail pin complete.
1—Ohio knuckle lock complete.
1—Uncoupling lever clevis complete.
1—Brake chain clevis complete.
1—Monkey wrench.
2—White pine reservoir drain plugs.

The car foremen in charge of the stations where the trucks are used are held responsible for keeping a full stock of material in the trucks at all times. Employees of the car department are the only ones authorized to have access to them, and this only in case of actual emergency. When any material is removed it must be accounted for and replaced by the employee using it. The truck is assigned to a definite location where it will be most convenient for the men who are using it, and care is taken to see that it is kept fully supplied and secured by a standard repair track lock at all times when not actually in service. These trucks have proved a great convenience and 50 are now in use on the C. M. & St. P. system.

Photograph by Press Illustrating Service, Inc., N. Y.

Hospital Car Now Used in Evacuating Soldiers from Along the Line to the Base at Vladivostok

The Lubrication of Journal Boxes

Inspection and Care of Passenger and Freight Cars in Yards and Shops; Preparation of Packing

BY M. J. O'CONNOR
Special Inspector, New York Central

In view of the conditions that exist on practically all the railroads in the United States at the present time, the lubrication and care of rolling stock equipment is very important. The first and most important matter in connection with this feature of equipment maintenance is standard instructions, issued in book form, covering the preparation and maintenance of journal box packing, also the equipment necessary to handle the material as well as the tools, which is a very important matter in connection with the proper method of applying packing to journal boxes.

To handle the lubrication of equipment properly and to reduce hot boxes to a minimum, the following methods should be adopted: A suitable building should be fitted up with metal tanks equipped with ¼-in. mesh screens about three inches from the bottom of the tank and 1¼-in. faucets or molasses gates for drawing off the oil. The dimensions of these tanks should be in accordance with the requirements of the yard or shop, based on the number of cars handled per day. For example, at a large yard where from eight to twelve thousand cars per day are handled, in addition to a preparation tank, additional storage tanks should be maintained, in order to allow sufficient time for packing to become properly saturated in preparation tanks.

Preparation of Journal Box Packing

The waste must be carefully pulled apart and a known weight placed in the preparation vat, adding sufficient oil to completely submerge the waste (for 50 pounds of waste this will be 60 gallons of oil). Allow the packing to stand for 48 hours; draw off the excess oil (in above case this would be 35 gallons), leaving just sufficient oil to maintain the ratio of four pints of oil to each pound of dry waste. The work should be performed in a room at a temperature of about 70 deg. As the oil continues to drain, it should be drawn off from the bottom of the vat and poured back over the top of the waste, thus having the packing always ready for service. In tanks of two or more compartments, one can be used as storage for prepared packing, while the other is being used for the saturation of fresh packing.

It has been proved from experience that the waste used in the lubrication of passenger equipment cars, which is approximately 50 per cent cotton and 50 per cent wool, machine mixed, is superior to all wool, in that the fine cotton threads prevent excessive expansion and at the same time hold the material together, thus eliminating the lint which is produced by the revolution of the journal. The use of wool waste for the lubrication of freight cars is an unnecessary expense, as it has been found that as good results are not procured as from ordinary cotton waste. Cotton waste will retain the oil nearer the surface of the packing, which greatly assists the packer in knowing that the packing contains sufficient oil, whereas with all wool waste the oil precipitates to the cellar of the journal box with the result that it requires more than normal friction to convey the oil up to the surface of the journal.

The man in charge of the oil room should be thoroughly instructed to drain off the oil that settles in the bottom of storage tanks, and to pour it back over the packing several times daily. When the oil is poured over the packing it must be equally distributed to cover the entire surface of the packing contained in the storage tank. The oil rooms should be kept clean and free from dust and other foreign matter at all times, and no dry waste or wiping towels allowed to be carelessly thrown in or mixed with the packing.

In addition to these tanks, it is necessary to have a metal container to hold rolls that have been made up of dry waste, which have later been submerged in oil. These rolls are to be used without carrying much oil, or in other words, moderately dry, in order to have them ready to apply to boxes at all times. The standard dimensions of these rolls is 2½ in. in diameter by about 11 in. in length. These rolls assist in better excluding the dirt in the back of boxes as well as holding the oil in the box.

A standard dope bucket should be used for handling prepared packing and nothing else. After a train of cars has been gone over by the yard or shop doper, all packing remaining in the bucket should be placed back in the storage tank until necessary to go over the next train of cars.

Method of Packing Journal Boxes

First place the prepared roll in the mouth of the box, using care to center the roll, then it should be shoved back evenly under the journal with the packing iron so that it is in the proper position when it reaches the extreme back of the box. The packing should be picked up by hand and placed across the entire mouth of the box. This is absolutely necessary in order to keep the packing evenly distributed in the operation of placing it in the box. This method insures even distribution while being placed in the box due to feeding the packing in a continual strand under the journal (not on the sides) until the box is completely packed to the center line of the journal, straight down from the inside face of the collar. No packing should extend beyond the end of the journal. It has been proved that the elimination of the so-called front waste plug affords the inspector a better opportunity to examine the contained parts of the journal box, as well as assisting the doper to know that when packing extends beyond the journal collar, there is either surplus packing in the box or else the packing has worked outward. In either case, the remedy is immediately applied.

When wheels are applied, the journals should be thoroughly cleaned, and the bearing surface of the brasses coated with oil. No waste either dry or saturated should be used in oiling the journal bearing, to avoid any particle of waste or foreign substance remaining on the journal bearing when it is applied. Tight fitting dust guards should be applied in all cases when wheels or journal boxes are applied. Where new journal boxes or integral truck sides are applied, the interior of the boxes should be free from scale and sand or any other foreign substance.

Care of Packing in Journal Boxes

All passenger equipment cars are to have the packing removed, bearings examined and the boxes repacked in accordance with the foregoing instructions, as the cars go through the shops for general overhauling or where terminal facilities will permit. Passenger equipment cars operated in through and important service must have the packing re-

[1]From a paper presented before the Car Foremen's Association of Chicago, April 14, 1919.

moved, bearings inspected and boxes repacked once every six months thereafter; letters "NP," together with the date and initials of the place to be stenciled on the right-hand corner of the outside of the truck when so repacked.

Journal boxes of freight equipment cars must have the packing removed, bearings examined and boxes repacked as the cars go through the shop or on repair tracks, if the stenciling indicates that they have not been repacked within nine months. When newly packed or repacked, they must be stenciled as to the date and place of repacking.

When the movement of cars is reversed while en route, the proper adjustment of packing is very important, as it is found that the packing works to the rising side of the journal in a great many instances and will remain in that position in the reverse movement if not readjusted, causing the journals to heat, as packing in this position will not feed oil to the journal. Special instructions should be issued to the packers that where box lids are found difficult to open, they should obtain assistance from the running repairer or inspector. In no case should a box be jacked up in the yards or shops without first removing all the packing.

The most important part of the work for the successful lubrication of equipment is intelligent attention to the condition of the packing in the journal boxes, which, briefly, consists in loosening up the packing to avoid the hardened and glazed condition resulting from too long a contact with the journal, then loosening the packing by pulling it forward from the sides and working it back under the journal at the center. If new packing is needed, it should be worked back under the journal from the center by this method, thus raising the portion on the sides, care being taken that it is not lifted above the center line of the journal on either side.

When a car is found with a hot box or a mark indicating a hot box, a careful inspection must be made to ascertain the cause of heating. If the journal is smooth, a new brass should be applied and the box repacked with fresh packing. If the journal is rough, a new pair of wheels must be applied. Under no circumstances must a journal which has been heated be reapplied to a car unless it is in a perfectly smooth condition. A journal which has been heated sufficiently to discolor it, must never be reapplied to a passenger equipment car regardless of its condition in other respects.

The inspection and application of journal bearing wedges is a very important matter. In not more than one-half of one per cent of the cases where journal bearings are applied are the wedges renewed, and this is done only where the wedge lugs are badly bent or broken. This condition would indicate that the proper inspection is not made to ascertain whether or not the wedge has any crown. All new journal bearing wedges have a crown of about one-sixteenth of an inch and this crown should be maintained to obtain good results.

RECLAMATION OF JOURNAL BOX PACKING

All packing when removed from journal boxes should be pulled into a bucket, avoiding contact with the ground or any other place where it may pick up dirt, and taken to points designated on the several divisions for reclamation. In reclaiming packing, it should first be picked over carefully, the heavy dirt, metal, etc., shaken out, the knotted strands of waste pulled apart and then placed in the hot oil compartment of the "reclaiming tank." Not more than six to eight inches in depth of packing should be carried in the hot oil tank at any one time, as this insures thorough cleansing. Ten to fifteen minutes in the hot oil is sufficient. The temperatures of the oil must not exceed 180 deg. nor be less than 150 deg. The height of the oil in the hot oil compartment should be maintained to within about six inches of the top so that the waste may be washed in a pool of hot oil as it is removed.

After removal from the hot oil bath, the waste should be placed on the drainage rack on the hot oil side of the reclaiming tank and allowed to drain until the oil and water are well out of it. Only a small amount of packing should be carried on the drain rack at one time in order to facilitate drainage. After proper drainage has been effected, the waste should be transferred to the cold oil compartment for resaturation, this requiring about twenty or thirty minutes. When removed from the cold oil compartment, the packing should be placed on the drainage rack in the cold oil side of the reclaiming tank and allowed to drain until it has reached the proportion of four pints of oil per pound of waste (this condition being determined by the flow of oil under light pressure between thumb and finger), when it must be placed in a storage tank to prevent further drainage.

The hot oil compartment should be cleaned at intervals of two weeks or oftener where the volume of material handled warrants it. Oil should be extracted from all sediment removed, by pressure or drainage, and the oil thus extracted should be run through the separator and then returned to the hot oil compartment of the reclaiming tank.

The reclamation of journal box packing answers two very important purposes. First, it insures the material removed from boxes being placed back in them in a very much improved condition, so much so that the results obtained from its use where new journal bearings are applied has been very gratifying. These results are due in a measure to the reclaimed material being more thoroughly saturated than new, also forming a more compact body, thereby conveying the oil to the journal more readily. Second, it is a check against the shop doing this work; for example, a certain shop receives 10,000 lb. of prepared packing in a given period; nearly the same amount should be removed from boxes as compared with that applied. If a reasonable amount is not sent back investigation will develop that the boxes repacked have not been handled in accordance with instructions; in other words, the boxes have been overpacked or else the material removed has been carelessly thrown on the ground.

Truck conditions contribute very materially to the cause of journals heating on freight cars, as for example, the absence of nuts from column bolts and box bolts. Where the nut is missing from the column bolt, invariably the arch bar springs up, throwing the weight on the journal box and putting the box out of line. Where box bolt nuts are missing on trucks passing over low joints and crossovers, it has a tendency to allow journal bearing to become unseated from time to time with the result that packing becomes wedged between the journal and the bearing, also causing journal bearings to become broken. Cars with the arch bars worn at the column and box bolt holes, allow the box to cant inward causing the journal bearing to ride partially on the side of the journal. This defect of worn bolt holes is due primarily to nuts missing from bolts or nuts not drawn home, which allows the bolts to keep working upward and downward and also to turn when the car is in motion.

Another matter that contributes to journals heating is the absence of grease on center plates and friction side bearings. It has been found that body side bearings wearing into the truck side bearings causes the truck to bind, thereby throwing the weight to one side. This condition is due principally to center plates and side bearings not being greased. All empty cars making shop track movement should have the center plates and side bearings greased, also loaded cars where trucks have been removed. The proper time to correct these conditions, particularly on private owned cars, is when cars are home.

In order to maintain standard instructions and practices at all points on any one railroad, an experienced man with authority should be assigned to follow up this work exclusively, and where this is done, a performance of approximately 150,000 miles per car per hot box on passenger equipment cars and 30,000 miles per car per hot box on freight cars has been obtained. The basis upon which this performance is compiled includes cars arriving at terminals which have caused no delay as well as those which have caused delay to the transportation department.

DISCUSSION

There was considerable discussion of the advantages and disadvantages of packing boxes without the front waste plug. The majority of members considered that better results were obtained when the plug was omitted. In connection with the reclamation of waste, attention was called to a mechanical reclamation process in which no washing oil is used. Three machines are employed, a combination oil extractor and filter, a mechanical cleaner and an impregnator which saturates the waste with oil. With this equipment it was stated that one man can reclaim 100 lb. of waste per hour.

Creosote Treatment of Car Timbers

Methods Used by Marsh Refrigerator Service Co., Cost of the Work and Estimates of Increased Life

THE preservative treatment of lumber for use in car construction is a matter which has received considerable attention from railroads during the past few years. The possibilities for increasing the life of timber and thus reducing the cost of maintenance by such methods are now generally realized although treated lumber has not been used in the construction of cars for a sufficient length of time to determine the life which can be secured from treated sills, flooring or roofing. The method of treating cross ties and piling is different from the process used in applying preservatives to car timbers, and for that reason the life secured from structural timber when treated with preservatives does not indicate the length of service that may reasonably be expected from treated lumber used in car construction.

The Marsh Refrigerator Service Company, Milwaukee, Wis., has used the creosote treatment for sills and roofing applied to refrigerator cars for some time past. In order to determine the amount of impregnation being secured by the method of treatment used on these parts and to estimate the probable average life of the treated lumber, this company recently conducted a series of tests of the process of creosoting sills and roofing. The material creosoted consisted of standard refrigerator car sills 5 in. by 8 in. by 35 ft. and roof boards and sub-flooring 1 in. by 4 in. by 5 ft. All the lumber was southern yellow pine, the average grade being No. 1 common. The average density was approximately 8 annular rings per inch and about 30 per cent was summer wood. The lumber was all kiln-dry stock and was well seasoned, the average dry weight being 25.6 lb. per cu. ft.

TREATMENT OF SILLS

Seven sills fully framed, with mortises and tenons cut and bolt holes drilled, were taken from stock at random for the test. The individual sills were numbered and were weighed both before and after treatment. The preservatives used in the treatment of all the lumber was Carbosota, a liquid creosote oil, conforming to United States Railroad Administration specifications R 828-A. Sills numbers one to seven inclusive were subjected to a hot treatment for six hours, being completely submerged in the creosote oil, which was held at an average temperature of 150 deg. F. The steam was then shut off, and the timbers were permitted to cool for 11 hours, after which they were removed from the treating tanks and placed on a dripping rack, where they were permitted to drain for six hours. The temperature of the oil when the sills were removed was 120 deg. F.

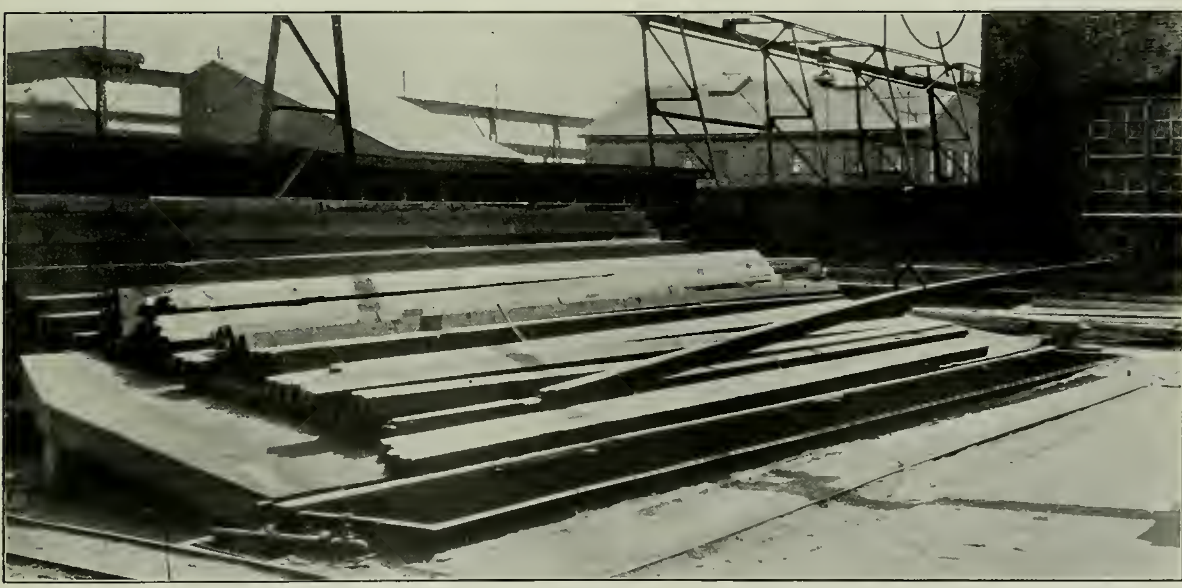


Fig. 1—Tank in Which Sills Are Treated with Creosote Oil

Sills numbers eight to ten inclusive were given a shorter treatment in the hot oil, the preservative being heated for only one hour during which the average temperature was 125 deg. F. The cooling treatment was continued for 11 hours, and upon the completion of the treatment the creosote oil was about 100 deg. F.

After draining the sills were weighed to determine the amount of creosote absorbed. The result of the treatments are shown in Table 1 below.

Table I

Weight of Sills Before and After Treatment Showing Absorption of Creosote Oil by Individual Timbers

Pc. No.	Estimated absorption: Total wt. before treatment, lb.	Total wt. after treatment, lb.	Wt. per cu. ft. before treatment, lb.	Wt. per cu. ft. after treatment, lb.	Net increase per cu. ft., lb.	Lb. per surf. sq. ft.	Moisture: Lb. per cu. ft.	Per cent
CHECK SPECIMENS								
1A	16.5	23.0	33.0	46.0	10.5	..	1.8	5.8
2B	27.0	58.0	27.0	58.0	28.1	..	Oven dry	..
3C	15.5	24.0	34.1	54.5	17.6	..	2.9	9.2
4D	22.0	24.0	52.4	57.1	1.9	..	18.1	52.7
CAR SILLS								
1	365.0	475.0	37.6	49.0	8.87	1.13	5.43	20.6
2	405.0	489.0	36.0	46.2	7.85	1.0	4.88	15.6
3	335.0	425.0	34.5	43.8	7.07	.9	3.34	10.7
4	350.0	449.0	36.0	46.2	7.90	1.0	4.88	15.6
5	350.0	524.0	36.0	54.0	15.24	1.9	4.88	15.6
6	352.0	483.0	36.3	49.8	11.0	1.4	5.1	16.4
7	332.0	471.0	34.2	48.5	11.90	1.5	3.03	9.7
Averages	355.6	473.7	35.85	48.24	9.97	..	4.65	15

As will be noted there was a considerable variation in the amount of creosote oil absorbed. Piece No. 2-B was impregnated throughout, the estimated absorption being 28 lb. per cu. ft. This exceptionally heavy impregnation was no doubt due to the slightly dotey condition. On the other hand, specimen 4-D absorbed only 1.9 lb. of creosote oil per cu. ft., due to the practically green condition of the timber which was also fairly dense and contained a large percentage of summer wood. Specimen 1-A is representative of the average grade of timber. This piece absorbed about 10 lb. per cu. ft., the penetration obtained being shown in Fig. 2, which represents sections cut about 4 inches from the end and from the center of the stick. As will be noted, the portions of the timber exposed to decay have been thoroughly treated.

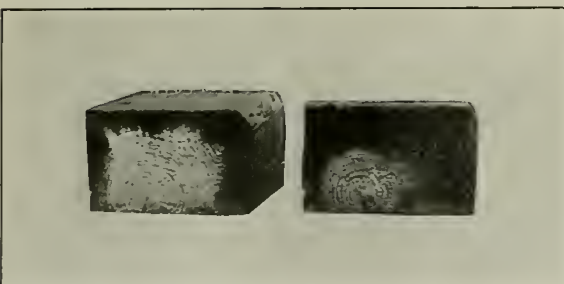


Fig. 2—Sections Through Treated Sill Showing Penetration of Creosote

The average absorption of 10 lb. per cu. ft. which was obtained with sills No. 1 to 7 inclusive indicates the possibilities of the open tank method of treatment with refined coal tar creosote oil under proper conditions. The lack of penetration in the case of piece 4-D shows the need for thorough seasoning of wood to be treated by the non-pressure process. Unless the wood is thoroughly dried satisfactory results are in most cases not obtained.

The results obtained on sills No. 8 to 10 are shown in Table 11.

Table II

Weight of Sills and Absorption of Creosote with Short Treatment in Hot Oil

Pc. No.	Estimated absorption: Total wt. before treatment, lb.	Total wt. after treatment, lb.	Wt. per cu. ft. before treatment, lb.	Wt. per cu. ft. after treatment, lb.	Increase in wt. per cu. ft., lb.	Lb. per surf. sq. ft.	Gals. per 100 sq. ft. surf.	Moisture: Lb. per cu. ft.	Per cent
8	312.5	340.5	32.23	35.10	2.87	.368	4.1	1.03	3.3
9	365.0	381.0	37.63	39.28	1.65	.210	2.3	6.43	20.6
10	342.5	370.0	35.31	38.14	2.83	.361	4.0	4.11	13.2
Averages	...	...	35.06	37.51	2.45	.313	3.5	3.86	12.37

The small absorption in these specimens proves the necessity for a long hot treatment. As an approximate rule it may be stated that wood naturally resistant to the injection of creosote oil should be immersed one hour for each inch of the largest cross section in both the hot and cold bath. When treating woods not difficult to impregnate this time may be reduced one half. This applies to treatments where separate hot and cold baths are used, but where the timbers are left in the hot creosote oil until it cools, the cooling treatment should be carried on for 10 to 12 hours.

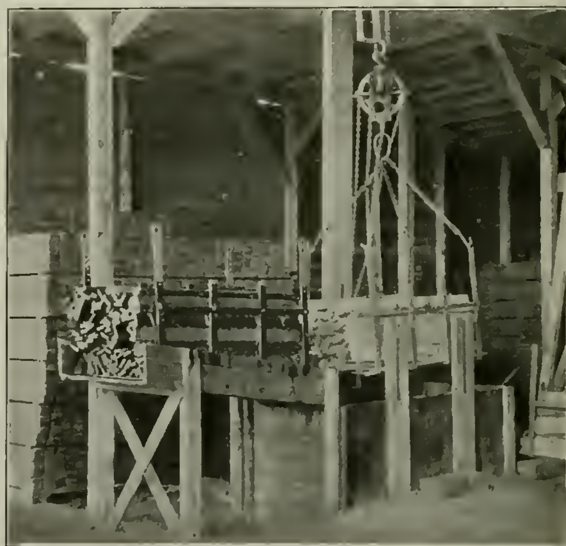


Fig. 3—Devices for Handling Roof Boards During Treatment

The theory of the process described above is that during the hot treatment the heat of the preservative expands and expels a portion of the air and water contained in the wood cells. Then upon immersion in the cold bath or upon the gradual cooling there is a partial contraction and the condensation of the air and water remaining in the wood results in a slight vacuum being formed. This, aided by atmospheric pressure and capillary action between the wood cells and the preservative, causes the actual impregnation with oil.

TREATMENT OF ROOF BOARDS AND SUBFLOORING

Ten pieces of roofing material 1 in. by 4 in. by 5 ft., taken at random from stock, were numbered and weighed. These pieces were then bundled together and were creosoted by immersion in the heated creosote oil only. Because of the small cross section of this lumber the standard open tank process used in treating the sills was not required. Pieces No. 0 to 9 inclusive were submerged for a period of 45 min. at an average temperature of 160 deg. F. They were then removed from the tank and allowed to drain, after which they were weighed to determine the absorption of creosote oil. The impregnation was somewhat greater than is necessary under the conditions of service for which this material is used. The average absorption secured by this method, as shown in Table III, was approximately 6.55 lb. per cu. ft. The expense of such treatment would probably not be warranted for this material.

TABLE III

Absorption of Creosote by Roof Boards Immersed for 45 Minutes

1 Pc. No.	2 Total wt. before treatment, lb.	3 Total wt. after treatment, lb.	4 Total increase in wt., lb.	5 Wt. per cu. ft. before treatment, lb.	6 Wt. per cu. ft. after treatment, lb.	7 Est. absorpt'n increase in wt. per cu. ft., lb.
0	2.81	3.25	0.43	20.23	23.38	3.15
2	2.65	3.68	1.03	19.10	26.52	7.42
5	3.06	3.07	0.01	22.03	22.14	0.11
6	2.75	3.12	0.37	19.78	22.48	2.7
7	3.81	3.89	0.07	27.43	27.99	0.56
Averages	3.29	4.20	0.91	23.69	30.24	6.55

Pieces No. 10 to 19 inclusive were submerged in the creosote oil for 30 min. at an average temperature of 153 deg. F. The absorption as shown in Table IV indicates that the results are satisfactory for the purpose, the average absorption being about 2½ lb. per cu. ft.

TABLE IV

Absorption of Creosote by Roof Boards Immersed for 30 Minutes

Pc. No.	Total wt. before treatment, lb.	Total wt. after treatment, lb.	Total increase in wt., lb	Wt. per cu. ft. before treatment, lb.	Wt. per cu. ft. after treatment, lb.	Est. absorpt'n increase in wt. per cu. ft., lb.
10	2.84	3.07	0.234	20.46	22.14	1.68
11	3.09	3.21	0.125	22.24	23.15	0.91
12	3.40	3.43	0.031	24.51	24.73	0.22
13	2.59	3.06	0.468	18.66	22.03	3.37
14	3.93	6.00	2.062	28.33	43.17	14.84
18	3.53	3.60	0.078	25.40	25.96	0.56
19	3.87	3.93	0.962	27.87	28.32	0.45
Averages	3.55	3.88	0.331	25.56	27.94	2.38

CARING FOR TIMBER BEFORE TREATING

The proper drying of lumber before treating is of great importance, but satisfactory results can be secured with stock that has been thoroughly air dried. Timber should be piled in such a manner as to permit a constant circulation of air around each individual piece, and care should be taken to avoid contact with wood that has started to decay. If creosoted sills are available they should be used as the foundation for the pile. In no case should timber be piled on cinder fillings or where vegetation can come in direct contact with it. Sills before being placed in the creosote oil should be fully framed and all mortises and tenons should be cut and all bolt holes drilled.

EQUIPMENT USED FOR CREOSOTING

The equipment required for treating lumber with creosote oil is extremely simple, and both the initial cost and the cost of operation are low. The tank in which sills are treated at the plant of the Marsh Refrigerator Service Company is shown in Fig. 1. It is about 50 ft. long, 4 ft. wide and 4 ft. deep, with steam coils in the bottom for heating the oil, and is located in a portion of the yard served by a crane, which greatly facilitates handling the timber. It has been found that some lumber will float in the creosote, and to correct this the tank is to be fitted with a device for holding down the sills during treatment.

For treating the roof boards and the subflooring a smaller tank is used, shown in Fig. 3. This tank is made of wood lined with tin, and is 3 ft. wide, 6 ft. long and 2 ft. 6 in. deep. The boards to be creosoted are piled loosely in frames made of iron bars. About 150 to 200 pieces are placed in the frame which is raised by a chain hoist and lowered into the creosote. Levers attached to the frame above the tank are used to insure complete immersion of the lumber. After being treated about 30 min. the frame is placed on the drying rack to allow the surplus oil to drain off, after which the material is ready to be placed in storage.

The timber which has been creosoted, particularly the subflooring and roofing, is given an opportunity to dry thoroughly before it is placed in the cars. With the refined coal tar creosote oil the material dries readily in from two to three days during fair weather. In order to permit of keeping on hand a stock of dry creosoted material sufficient to meet the requirements, storage space is provided for an extra stock in excess of that required to permit the material to dry. Roofing and flooring is treated during the summer months in sufficient quantities to provide a supply to last through the winter, as this work can be more readily handled during the warm weather.

COST OF PRESERVATIVE TREATMENT

The average cost of treating sills 5 in. by 8 in. by 35 ft. has been estimated as follows:

Creosote oil, 10 lb. per cu. ft. for 9.7 cu. ft. (10.8 gal.)	$4.00
Labor and overhead	.50
Total cost per sill	4.50
Cost per thousand feet, board measure	38.54

In treating the subflooring and roofing two men handle approximately 400 pieces per hour, making the labor cost per piece $.0005. Overhead is estimated at $.0005 and the cost of creosote oil at 8 lb. per sq. ft. of surface makes a total cost per piece of about $.018 or $10.65 per thousand feet board measure.

ECONOMY OF TREATED MATERIAL

It is estimated that the treatment of lumber for refrigerator cars will result in a large saving. The average life of untreated roofing boards has been found to be approximately six years. Creosoted material in the same location, unless destroyed by abrasion, should last from 12 to 15 years. The life of the sills should be correspondingly increased. The savings effected will be much greater than would be indicated by the reduction in cost of the material over a given period of years, especially in the case of the sills, as the replacement of these parts entails not only a loss equal to the value of the sill and the labor of applying it, but also the value of such other material as may be destroyed or made unfit for further use in replacing the decayed sills.

TRACK CURVATURE IN CAR DESIGN

BY ALBERT H. LAKE, JR.

In the design of the modern railroad car having pivoted trucks, it is necessary to know the radius of track curvature over which the car will pass without interference of the wheels with the car body, the brake rods or the brake pipe, and also to ascertain if the striking plate is of sufficient depth to avoid interference at the corner of the car or push pole pocket.

With the following formulae and table, used in connection with Figs. 1 and 2, these clearances may easily be calculated. The angle A and the distance H may be found by the use of Fig. 1 and the formulae. Referring to Fig. 1:

A = The angle formed by lines drawn from the truck center and the center of the car to the radius point O and is also the angle formed by the center lines of the car and of the truck, as these angles are always equal.

B = The angle formed by lines drawn from the pulling face of the coupler, with the horn against the striking plates, and the center of the car to the radius point O.

C = Distance from center to center of trucks.

$D = \frac{1}{2} C$.

E = Distance from the center of the truck to the face of the end sill or interference point at the corner of the car.

F = Distance from the center line of the car to the face of the side sill or interference point at the corner of the car.

G = Distance from center of car to the radius point O.

H = Distance from the face of the end sill or interference point at the corner of the car to the pulling face of the coupler with the horn against the striking plate.

$K = G - F$.

R = Radius of track curvature.

With the foregoing values the formulae are:

(1) $\text{Sine } A = D \div R$

(2) $G = R \times \cos. A$.

(3) $K = G - F\ (R \times \cos. A) - F$.

(4) $\text{Cot. } B = \dfrac{K}{D + E} = \dfrac{(R \times \cos. A) - F}{D + E}$

(5) $H = (G \times \tan. B) - (D + E) = [(R \times \cos A) \times \tan. B] - (D + E)$

The following example will illustrate the use of the formulae for Fig. 1. Let R = 100 ft. 0 in., C = 30 ft. 0 in.,

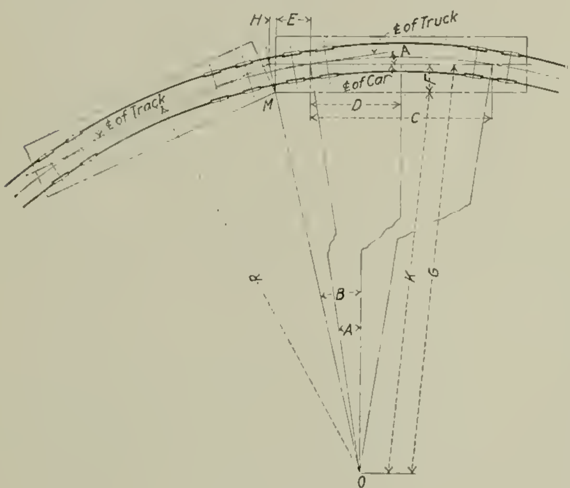


Fig. 1

D = 15 ft. 0 in., E = 5 ft. 6 in. and F = 4 ft. 9 in. From the table the angle A = 8 deg., 38 min. and cosine A = 0.9886.

Using formula (4)

$$\text{Cot. } B = \frac{(100 \times 0.9886) - 4.75}{15 + 5.5} = \frac{94.11}{20.5} = 4.59073$$

B = 12 deg., 17 min.; tan. B = 0.2177

Using formula (5)

$H = [(100 \times 0.9886) \times 0.2177] - (15 + 5.5) = 21.52 - 20.5 = 1.02$ ft.

It should be noted that formula (5) for the distance H does not consider the swing of the coupler sidewise, which varies to suit the detail of the striking plate.

Fig. 2 is used to find the distance of the highest point of the wheel flange from the center line of the car and also the travel of the truck side bearing. Referring now to Fig. 2:

A = The angle between the center line of the car and the center line of the truck, also between the center lines of the body and truck bolsters, and the axles.

B = The distance from the center line of the car to the center line of the side bearing.

C = Travel of the truck side bearing.

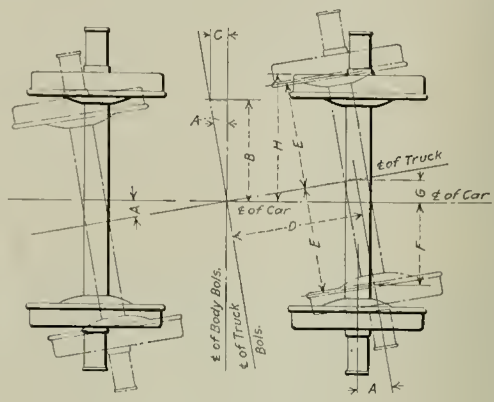


Fig. 2

D = The distance from the center line of the truck to the center line of the axle.

E = The distance from the center line of the truck to the highest point on the wheel flange.

F and H = The distance from the highest point on the wheel flange to the center line of the car.

G = The distance from the center line of the car to the center line of the truck at the axle.

The angle A is the same as in Fig. 1 and is found by formula (1) or from the table.

With these values the formulae for Fig. 2 are:

(6) $C = B \times \text{sine } A$

(7) $G = D \times \text{sine } A$

(8) $F = (E \times \cos. A) - G = (E \times \cos. A) - D \times \text{sine } A)$

(9) $H = (E \times \cos. A) + G = (E \times \cos. A) + (D \times \text{sine } A)$

The following example will illustrate the use of the formulae for Fig 2. Let A = 8 deg., 38 min.; B = 2 ft. 1 in.; D = 2 ft. 9 in., and E = 2 ft. $3\frac{1}{4}$ in. From the table, sine A = 0.1500; cos. A = 0.9886.

Using formula (6)

C = 2 ft. 1 in. × 0.1500 = 3.75 in.

Using formula (8)

F = (2 ft. $3\frac{1}{4}$ in. × 0.9886) — (2 ft. 9 in. × 0.1500) = 21.99 in.

Using formula (9)

H = (2 ft. $3\frac{1}{4}$ in. × 0.9886) + (2 ft. 9 in. × 0.1500) = 31.89 in.

For convenient reference the data may be calculated and tabulated as shown in the table.

Table Giving the Angle A and the Corresponding Sine and Cosine for for the Radii of Curvature and Truck Centers

Ctr. to ctr. of trucks	80 ft. radius			100 ft. radius			120 ft. radius			140 ft. radius		
	Angle A	Sine	Cosine	Angle A	Sine	Cosine	Angle A	Sine	Cosine	Angle A	Sine	Cosine
20 ft. 0 in	7° 11′	0.1250	0.9921	5° 45′	0.1000	0.9949	4° 47′	0.0833	0.9965	4° 6′	0.0714	0.9974
21 ft. 0 in	7° 33′	0.1312	0.9913	6° 2′	0.1050	0.9944	5° 1′	0.0875	0.9961	4° 18′	0.0750	0.9971
21 ft. 6 in.	7° 43′	0.1343	0.9909	6° 10′	0.1075	0.9942	5° 8′	0.0895	0.9959	4° 24′	0.0767	0.9970
22 ft. 0 in.	7° 54′	0.1375	0.9905	6° 19′	0.1100	0.9939	5° 15′	0.0916	0.9958	4° 30′	0.0785	0.9969
22 ft. 6 in.	8° 7′	0.1412	0.9899	6° 28′	0.1125	0.9936	5° 23′	0.0937	0.9956	4° 36′	0.0803	0.9967
23 ft 0 in.	8° 16′	0.1437	0.9896	6° 36′	0.1150	0.9933	5° 30′	0.0958	0.9954	4° 43′	0.0821	0.9966
24 ft. 0 in.	8° 38′	0.1500	0.9886	6° 54′	0.1200	0.9927	5° 45′	0.1000	0.9949	4° 55′	0.0857	0.9963
24 ft. 6 in.	8° 49′	0.1531	0.9881	7° 2′	0.1225	0.9924	5° 52′	0.1020	0.9947	5° 1′	0.0875	0.9961
25 ft. 0 in.	8° 59′	0.1562	0.9877	7° 11′	0.1250	0.9921	5° 59′	0.1041	0.9945	5° 7′	0.0892	0.9960
25 ft. 6 in.	9° 10′	0.1593	0.9872	7° 20′	0.1275	0.9918	6° 6′	0.1062	0.9943	5° 13′	0.0910	0.9958
26 ft. 6 in.	9° 32′	0.1656	0.9861	7° 37′	0.1325	0.9911	6° 20′	0.1104	0.9939	5° 26′	0.0946	0.9955
27 ft. 0 in.	9° 43′	0.1687	0.9856	7° 46′	0.1350	0.9908	6° 28′	0.1125	0.9936	5° 32′	0.0964	0.9953
27 ft. 6 in.	9° 54′	0.1718	0.9851	7° 54′	0.1375	0.9905	6° 35′	0.1145	0.9934	5° 38′	0.0982	0.9951
28 ft. 6 in.	10° 16′	0.1781	0.9839	8° 12′	0.1425	0.9897	6° 49′	0.1187	0.9929	5° 51′	0.1017	0.9947
29 ft. 0 in.	10° 27′	0.1812	0.9834	8° 20′	0.1450	0.9894	6° 56′	0.1208	0.9926	5° 57′	0.1035	0.9946
29 ft. 6 in.	10° 38′	0.1843	0.9828	8° 29′	0.1475	0.9890	7° 4′	0.1229	0.9924	6° 3′	0.1053	0.9944
30 ft. 0 in.	10° 49′	0.1875	0.9822	8° 38′	0.1500	0.9886	7° 11′	0.1250	0.9921	6° 9′	0.1071	0.9942
31 ft. 0 in.	11° 10′	0.1937	0.9810	8° 55′	0.1550	0.9879	7° 25′	0.1291	0.9916	6° 21′	0.1107	0.9938
32 ft. 0 in.	11° 33′	0.2000	0.9797	9° 13′	0.1600	0.9870	7° 40′	0.1333	0.9910	6° 34′	0.1142	0.9934
33 ft. 0 in.	11° 54′	0.2062	0.9785	9° 30′	0.1650	0.9862	7° 54′	0.1375	0.9905	6° 46′	0.1178	0.9930
33 ft. 6 in.	12° 5′	0.2093	0.9778	9° 39′	0.1675	0.9858	8° 1′	0.1395	0.9902	6° 52′	0.1196	0.9928
34 ft. 6 in.	12° 27′	0.2156	0.9764	9° 56′	0.1725	0.9850	8° 16′	0.1437	0.9896	7° 5′	0.1232	0.9923
35 ft. 0 in.	12° 38′	0.2187	0.9757	10° 5′	0.1750	0.9845	8° 23′	0.1458	0.9893	7° 11′	0.1250	0.9921

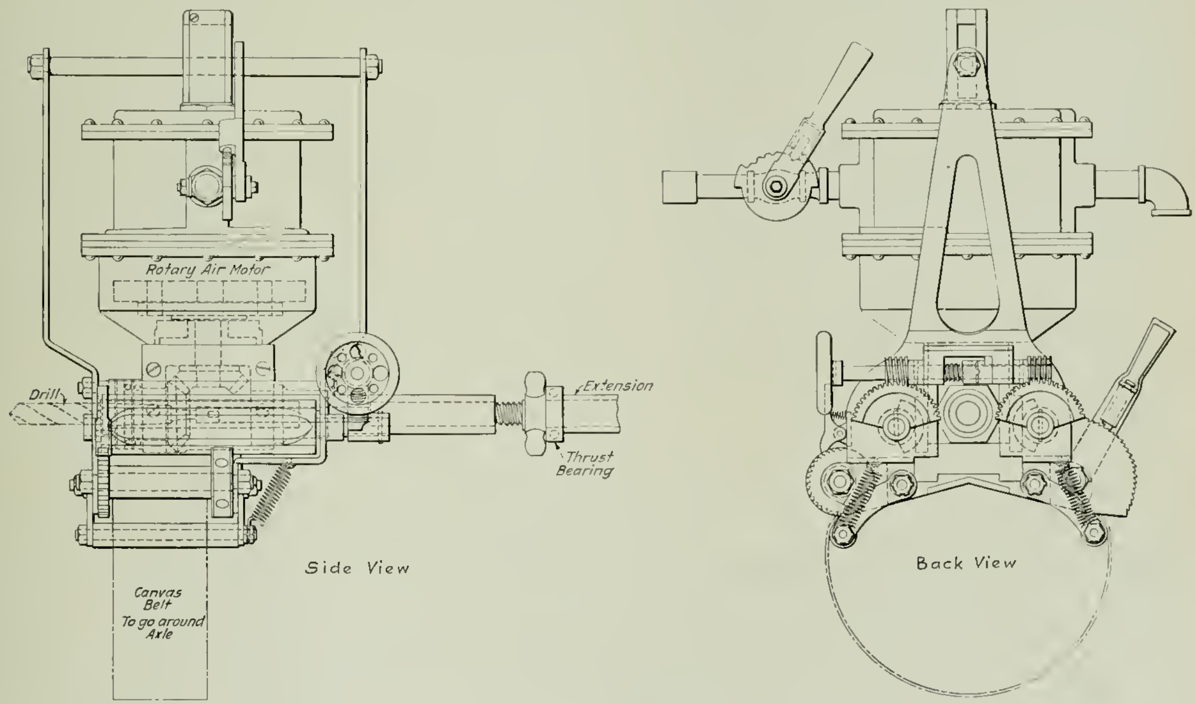
DRILLING HOLES FOR HUB PLATE STUDS

The work of drilling holes in driving wheel centers for holding hub plate studs is not easily performed with the ordinary air motor mainly on account of the difficulty of applying an "old man" on the axle. Furthermore, it is often difficult to get the proper alinement of the drill and air motor.

An ingenious device which saves considerable time in doing this work has been devised in the West Burlington shops of the Chicago, Burlington & Quincy, where it has been used with great success for some time.

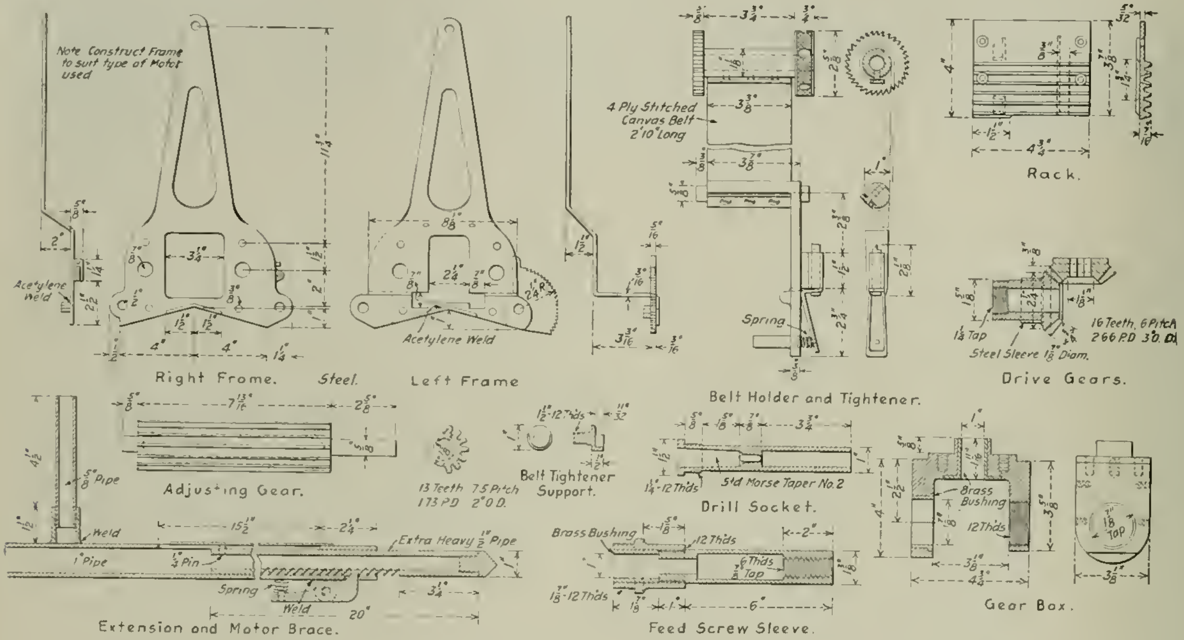
This machine, drawings of which are shown herewith, is arranged to clamp on the axle. It supports an air motor which drives a drill spindle, these parts being adjustable to bring the drill to any desired distance from the axle. The frame, *A* and *B*, is of 3/16 in. sheet steel with heavier sections welded on where necessary for bearings or other parts. On the lower end of this frame at one side is a spool which holds one end of a canvas belt 3⅜ in. wide and 2 ft. 10 in. long. The spool is fitted with a ratchet on one end and a wheel arranged with sockets for a short bar on the other end. The opposite end of the belt is attached to a tightener which is arranged to slip into the socket bearings *L*. To apply the machine it is set in place, the belt is slipped around the axle and the tightener is set in the sockets. The belt can then be adjusted by turning the spindle and tightened by pressing down the handle *K*.

The distance of the spindle from the axle is controlled by a hand wheel on the shaft *X*. This shaft carries right hand and left hand worms, and these engage worm wheels keyed to the shaft of two segmental adjusting gears. The adjusting gears in turn engage racks on the sides of the gear box which carries the drill spindle and driving gear. Thus by turning the hand wheel on the shaft *X* the spindle is moved radially toward or away from the axle. The width of the rack on the side of the gear box is 3 in. less than the length of the adjusting gears so the drill can be moved that distance parallel to the axle without resetting, this amount of adjustment being ample for the work on which the machine is used. The drill is fed by a hand wheel *R* which turns a feed screw *Q* in the sleeve *P* attached to the gear box, the extension *S* on the feed screw extending to the hub of the opposite wheel.



End and Side Elevation of Device for Drilling Driving Wheel Hubs

The drive is simple and is clearly shown in the illustration. The air motor is attached directly to the gear box, the end opposite the spindle being held by a guide which spans a rod across the frame. The bevel gear on the motor spindle engages another bevel gear which carries a socket for a No. 2 Morse taper shank, the inner end of which extends into a bearing in the feed screw sleeve. The gear which carries the drill socket has a ball thrust bearing and lock nuts on the end of the hubs which hold it in place in the gear box.



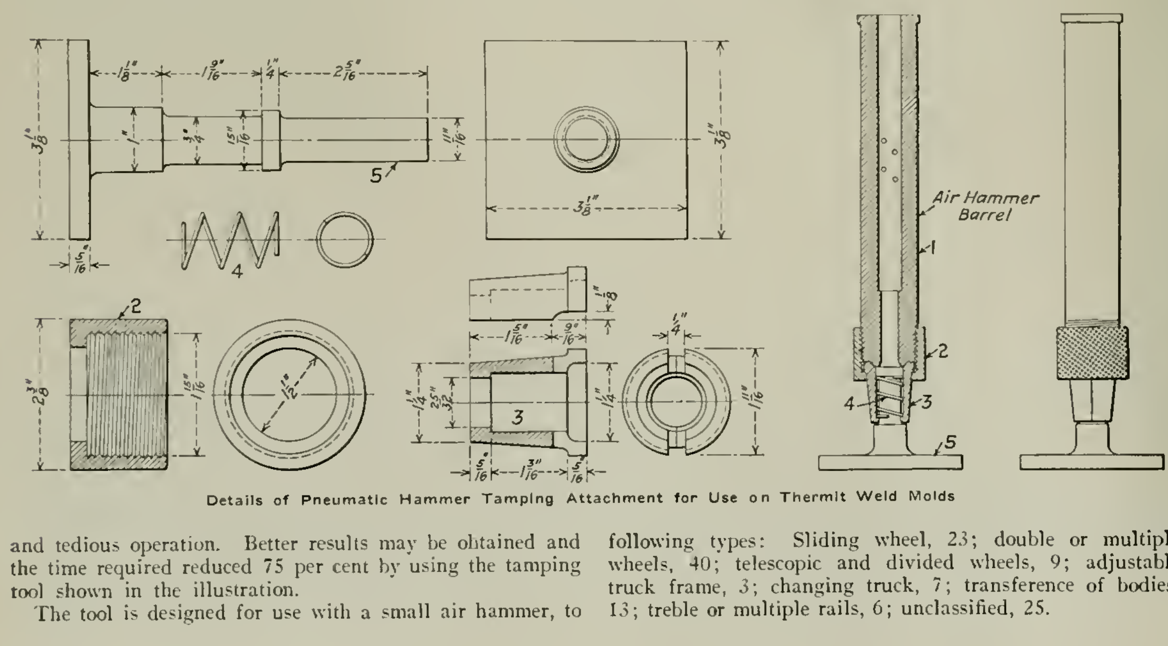
Details of the Hub Drilling Device

PNEUMATIC TAMP FOR THERMIT WELD MOLDS

BY J. F. D.

The practice on most railroads in making Thermit welds is to tamp up the mold box by hand. This is a rather long and tedious operation. Better results may be obtained and the time required reduced 75 per cent by using the tamping tool shown in the illustration.

The tool is designed for use with a small air hammer, to the end of the barrel of which is secured the special split fitting shown at *3* in the drawing. This is held in place by means of the nut *2*. The shank of the tamper works inside the fitting *3*; a coiled spring shown at *4* on the drawing is arranged within the fitting to effect the return stroke of the tamper after the blow of the hammer has driven it out.



Details of Pneumatic Hammer Tamping Attachment for Use on Thermit Weld Molds

Gage Difficulties in Australia.—The Federal railway authorities in Australia have had offered for their consideration no fewer than 126 different devices to meet the break of gage difficulty, but none has found favor. They are of the following types: Sliding wheel, 23; double or multiple wheels, 40; telescopic and divided wheels, 9; adjustable truck frame, 3; changing truck, 7; transference of bodies, 13; treble or multiple rails, 6; unclassified, 25.

E. J. & E. Has Efficient Flue Shop

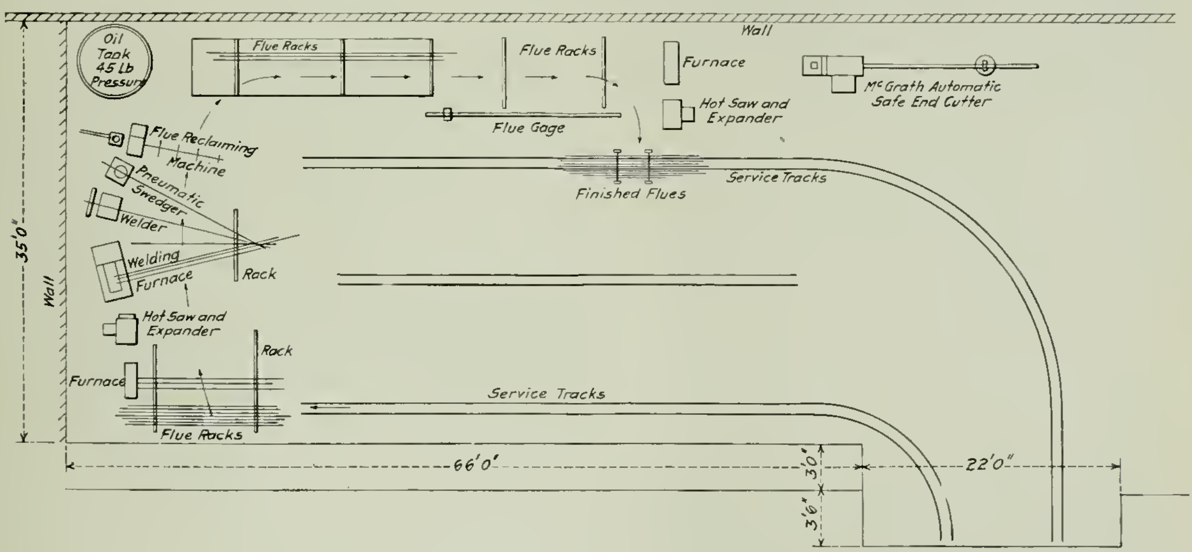
Rapid Production Secured with Small Force and Few Machines; Data on the Cost of Operation

THE locomotive repair shop of the Elgin, Joliet & Eastern at Joliet, Ill., has a flue shop which has made splendid records for high output and low unit cost. The plant includes a number of novel features which facilitate rapid production. One of the unusual points in connection with this layout is the fact that all the flue work excepting the removal of scale is handled on a balcony in the boiler department. In designing the shop it was thought desirable to provide ample room for the flue shop, and since the plan of the main floor did not present a favorable opportunity for securing the required space, the question of locating the department on the balcony was considered. The objection to this plan was the increased difficulty of handling the material. On the other hand, there were numerous advantages. The location on the balcony would keep the smoke and heat from the furnaces out of other parts of the shop, it would remove the tendency to encroach on the space devoted to flue work, and by reducing the space required on the ground floor would make a more compact layout possible.

The locomotive repair shop at Joliet is of the longitudinal type, approximately 400 ft. by 150 ft. The erecting bay extends along one side of the building. On the other side is a heavy machine bay served by a traveling crane and a light machine bay 35 ft. wide with a balcony. It was finally decided to locate the flue cleaner in the heavy machine bay with the remainder of the flue shop equipment on the balcony. A passageway 3 ft. wide extends along the balcony outside the columns on which the overhead crane runs, and by adding 3 ft. 6 in. to the width of the extension for a space of 22 ft. a landing stage was provided on which a set of flues can readily be handled. The flue shop was assigned a space about 35 ft. by 80 ft., which has proved ample for the work; in fact, a part is regularly used for storage purposes.

The layout of the machines in the shop is shown in the drawing reproduced herewith. Service tracks lead from the balcony to the first and last machines used in repairing the tubes, and in addition there is a storage track along the center. The tool equipment comprises two McGrath tube furnaces, two hot saws and pneumatic expanders (one equipped with a safe end magazine), a McGrath flue welding furnace, a Hartz flue welder, a Draper pneumatic flue swedger, a gaging stand, roller flue racks, a Ryerson boiler tube reclaiming machine and a McGrath safe end machine.

The operation of cutting the small tubes out of the boiler is performed in the usual manner by means of an air motor connected through a flexible joint to an expanding cutter. The large superheater flues are cut out of the boiler by the use of an oxy-acetylene cutting torch. The back ends of the tubes are cut out with an air hammer, after which the tubes are passed out through the front tube sheet and stacked on substantial standards built up of channels and flat bars, as shown in Fig. 1. The set of tubes or flues after being removed from the locomotive is picked up with chains attached to a yoke and set on stands, as shown in Fig. 2, until they are taken to the flue cleaning machine. The standards are of simple construction and provide ample space for passing chains around the tubes. The sets of tubes can be stacked one above another, and the space required is reduced to a minimum.



Layout of Flue Machinery on the Balcony

When the tubes are ready for cleaning they are taken to the flue cleaner or rattler, which is of the Ryerson pit type, and is shown in Fig. 3. An entire set of flues can be hoisted in chain slings and lowered into the pit onto the rolling chains of the rattler. The ends of the sling chains are fastened to hooks on the sides of the pit and left in position during the cleaning operation, as the flues rest on the rolling chains, and there is sufficient clearance between the tubes and the walls of the pit to keep the tubes from coming in contact with the chains. The tubes or flues are left in the rattler for from two to six hours, depending on the thickness and character of the scale. After the cleaning operation is completed, the sling chains are again hooked to the crane and the flues are raised out of the rattler and washed off with a hose, after which they are carried up to the balcony and deposited on the service track in the flue department, as indicated in the layout drawing.

The force employed in repairing tubes consists regularly of four men. The first man operates the hot saw, cutting off the rear end of the tubes, the second welds the safe end on the tube and swedges it, while the third cuts the front end of the tube and expands it. The fourth man is a helper, who assists in handling the tubes. When working on tubes more

Fig. 1.—Tubes Removed from the Locomotive Are Piled on Special Standards

than 18 ft. long an additional helper is required on account of the difficulty of manipulating the longer tubes.

The tubes undergoing repairs follow a predetermined course through the flue shop, as indicated on the floor plan by the series of arrows. From the car on the service track the flues are deposited on the roller flue rack adjacent to the first oil furnace. The front end of the tube is plugged with waste and the rear end is put into the furnace. Three or four flues are kept heating at one time to provide heated tubes as fast as they can be handled through the hot saw and

Fig. 2.—Tubes and Flues Stacked to Occupy Minimum Space

expander. The tube is heated just above the cherry red, and is then cut off in the hot saw shown in Fig. 4. The end is then inserted in the pneumatically operated expander. The movement of the expander is controlled by a hand-operated lever, which is arranged so that the movement of the latch operates the dies which hold the tube. Moving the lever forward opens a second valve, which forces the expander into the tubes and also releases a safe end from the safe end magazine at the side. The tube is next released from the expander, the safe end is forced into the end and the operator lifts the end of the tube over his head and inserts it in the welding furnace. The series of operations performed between

Fig. 3.—A Set of Flues About to Be Lowered Into the Pit Type Rattler

the first heating furnace and the welding furnace requires only five to seven seconds.

The welding furnace is especially designed for flue work

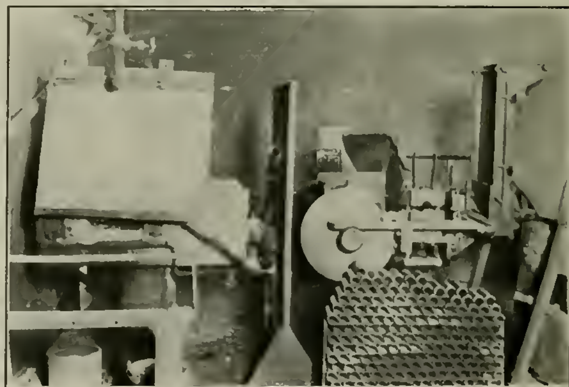


Fig. 4.—Furnace With Water Shield and Hot Saw and Expander With Safe End Magazine

and has three openings. The two openings farthest from the combustion chamber bring the metal up to a white heat, after

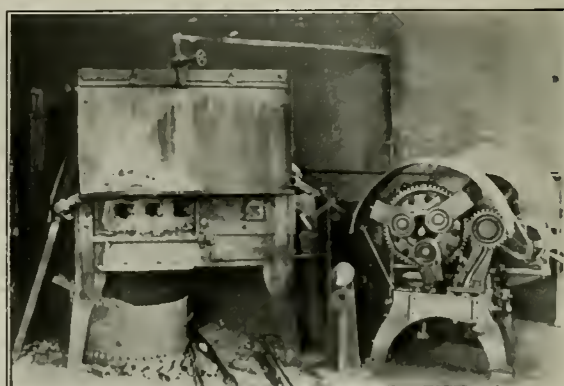


Fig. 5.—Welding Furnace and Roller Flue Welder

which it is placed in the opening nearest the combustion chamber for a few seconds, where the oxidizing flame brings it to a welding heat. The operator then removes the tube from the furnace and places it on the mandrel of the Hartz flue welder. By pressing down a treadle on the machine the revolving rollers are brought against the joints, welding the safe end to the tube. The operator then inserts the end of the safe end into the pneumatic swedger, reducing the size at the end and thus finishing the operation on the firebox end of the tube. The waste is then removed from the forward end of the tube and it is carried over to the roller flue rack and is pushed up within reach of the operator on the second hot saw.

The operation on the front end of the tubes consists in

Fig. 6.—Roller Flue Racks Serving Second Hot Saw and Gaging Stand

cutting to length and expanding slightly. The tube is inserted in the furnace until it is brought to the proper temperature for cutting. It is then removed and the back end is placed in the channel on the stop shown in Fig. 6, which has been set at the proper distance from the hot saw to make the tube precisely the length required. The tube is then placed in the expander with the back end resting against the angle stop, which brings it forward the proper distance to secure the required amount of expansion in the end of the tube. The finished tube after being removed from the ex-

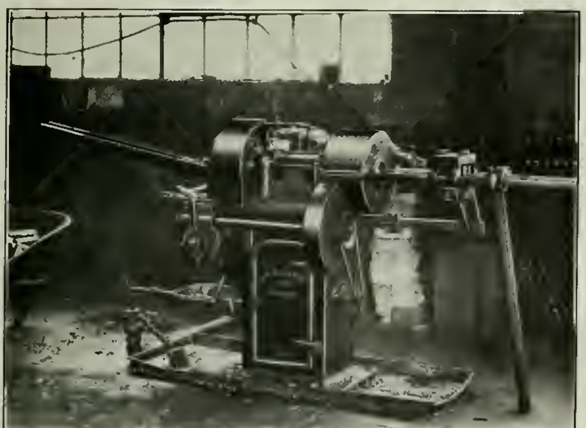


Fig. 7.—Automatic Machine for Cutting Safe Ends Reduces Labor in the Flue Shop

pander is placed on a car on the outgoing service track. The operator who works on the front end of the tubes marks them to indicate the various lengths and also attends to the automatic safe end machine, which is located just beyond the hot saw and expander. It will be noted that the tubes are not tested after being welded until they are subjected to pressure in the boiler. This policy was adopted because it was found that the proportion of defective welds was so small as to make testing of the individual tubes unnecessary.

The standard practice on the E. J. & E. is to apply not more than four safe ends on tubes or flues. When tubes are removed from the boiler which have been pieced four times they are cut and either used on smaller engines or have a single long tube welded on the end in the flue reclaiming machine. Superheater flues are handled with the same equipment used on the small tubes, the only alteration necessary being changes in the minor parts of some of the machines.

Records have been taken in the flue shop to determine the time required to finish a complete set of tubes. On one occasion, when the operators were working under favorable conditions, eight two-inch tubes 18 ft. long were completed in 2 min. and 40 sec., which is at the rate of a tube every 20 sec. or 108 tubes an hour. Another test was made with 47 two-inch tubes 22 ft. long, which were completed in 24 min. or at a rate of 117 tubes an hour. A third test on 22 two-inch tubes 18 ft. long required 8 min. 18 sec., or a rate of 158 tubes an hour.

The cost of applying safe ends to the tubes depends somewhat on the length of the tubes, the longer tubes requiring an extra helper. Including the cost of power for the rattler, oil and air for the furnaces, and labor for safe ending and cutting, the total cost for 18-ft. tubes will vary from 1.91 cents per tube at the rate of 180 per hour, to 3.18 cents at the rate of 100 an hour. For 22-ft. tubes the cost will be 2.16 cents per tube at 180 an hour, and 3.3 cents at 100 tubes an hour.

UNIFIED SHOP RECORD AND MANAGEMENT CONDITIONS

A committee was recently appointed from several roads in the Eastern Region, assisted by a representative from the mechanical department of the United States Railroad Administration, to visit a number of representative shops, collect data, and make a report as to the various methods of shop operation, supervision and shop records. Copies of the recommendations of the committee have been sent out to the federal and general managers of the Eastern Region by the regional director with Circular 1801-129A674, which states that while not mandatory, the recommendations if gradually adopted will secure uniformity in shop records and simplify many of the methods of procedure. The circular also suggests that, where no system is in use, the proposed plan may well be adopted. Reports are asked for as to what action is taken on the committee's recommendations.

The recommendations of the committee include the following:

SUPERVISION

The committee has paid particular attention to that supervision which comes in direct contact with the men, and invariably where the number of men assigned to one supervisor exceeded 30, a lack of activity was noticed.

It is generally conceded that shops on a day-work basis require more supervision than those on piece work, and after careful consideration it is recommended that the plan of assigning not more than 30 men to one foreman be adhered to as closely as practicable. The committee further recommends that this supervision be relieved of office clerical work during the work period; that shop staff and other meetings be held at other than the working period and that these supervisors be given the title of foremen rather than leaders.

CHECKING IN AND OUT

Your committee recommends a time clock system for checking men in and out; clock card should show employee's name, occupation and key number. Space should be provided on card for overtime as well as regular time. The same card should never be used beyond a payroll period and the one week card is preferable.

Clocks should be located convenient to the men's work and no clock should serve more than 125 employees. Unless existing agreements prohibit, clocks should be opened 15 minutes before starting time and closed promptly on whistle; opened promptly at quitting time and closed after all employees have checked out, with an attendant in charge of each clock during checking periods. This clock card should be used as a basis for payroll and checked against workmen's daily time cards.

Routing of Locomotive Work

Experience shows that any system of despatching or scheduling of work through the shop must be predicated upon: (1) A predetermined route; (2) a predetermined time limit.

With the above in view the general outline of a routing system is hereby made. In order to properly carry out the following routing it is necessary to have a competent schedule man, with authority, to follow up the system. The locomotive should be thoroughly inspected prior to entering the shop and the schedule man furnished with a copy of the inspection report from which the shopping schedule is prepared.

Separate forms should be made out by the schedule man covering parts to be repaired in various departments and furnished each foreman. These forms should show the locomotive number, class, date in and date scheduled out of shop and under the heading "Class of Work" the various units of the locomotive, condensed into not exceeding 30 items, to be listed in consecutive order in which the parts of the locomotive are dismantled and erected. Space should be provided opposite each of these items for the date the particular item is to be dismantled or repairs started, and the date the repairs are to be completed and erected. Space also should be provided opposite each of these items, for parts of the locomotive that it is necessary to send to the machine, smith or boiler shops, for the dates these parts should be received in the various shops and the dates they are to be completed. Space should also be provided opposite each item under the heading of "Remarks," for "Cause of delay," if any.

A "Daily Schedule Delay Report" should be furnished by the schedule man to the officers in charge, this form to cover all locomotives in shop on which any part is behind schedule. Opposite the individual engine numbers, space should be provided for the various units of repair, condensed into not exceeding 12 units of repair. Under the heading covering the units of repair space is to be provided for a check mark to show just what items are behind the schedule and are delaying the work, together with the causes of the delays.

A blackboard should be provided in each department, located in a conspicuous place, for the observation of the workmen as well as the foremen. All locomotives in shop requiring work in this department are to be listed on this board. At the top of the board should be shown the units of repair with which the particular department is concerned.

As the various parts of the locomotive reach the department a check mark opposite the locomotive number and under the parts is made. When repairs to these parts are completed and ready for delivery to the erecting shop, another check mark is made. When they are moved from the department, the check marks are erased.

By the use of this board it is possible for any one concerned to readily ascertain in just what department the repairs to the locomotive are being delayed.

Shop Order System

Shop or work orders should be issued to obtain the cost of manufacturing parts, repairing machines, cranes, etc., or, when desired, to determine the cost of a specific unit of locomotive repair.

After ascertaining that the necessary raw material is on hand, a shop order number should be assigned and a form issued giving the shop order number, requisition number, date issued, description, drawing number, pattern number and storehouse section. The accounting office should be notified so they may open the account.

The shop order clerk should then issue a card showing departments in which the work is to be performed and then enter in a book with duplicate stubs, kept for the purpose in the foreman's office, the work necessary in that department. After the department completes the work, the foreman will detach and return to the shop order clerk the duplicate slip. By this method it can readily be seen just what department has completed its share of the work.

When all slips have been returned, signifying the completion of the work, the accounting office is notified so it can close the account and compute the cost.

Where there is a sufficient amount of shop order work, it is recommended that a competent man be appointed, with authority, whose duty shall be to see that the work is promptly handled through to completion.

Accounting

Of the 10 shops visited, eight have in use daily time slips (paper) and two, daily time cards (light cardboard). In all cases except one the daily time cards are made out by the workmen and approved by the foremen. In the one case, the daily time card was also the clock card and the cards were filled out as to hours and distribution by time-keepers.

In all cases, locomotive numbers were shown and the number of hours spent on each, and distribution was drawn off to individual locomotives; arriving at a cost per locomotive as a unit.

The daily time cards in all but two cases provided space for description of work. In three of these cases some description was being shown and in the other seven none; but in no case were descriptions as shown considered specific and complete enough to form a basis of cost. Other than distribution to individual locomotives the only other information shown and the only other distributions made are those necessary to satisfy the requirements of the Interstate Commerce Commission classification of accounts.

Recommendations

It is recommended that one daily time card—size preferably 4 in. x 9¼ in.—of light cardboard paper be used. The card should show name, place, date, key number, occupation, department of shop and rate and should provide sufficient space for locomotive or shop order numbers, etc., description of work and hours worked. Total hours as shown by the daily time card of each workman should be checked with total hours indicated by registerings on his clock card.

After a careful consideration of this subject it is the opinion of the committee that it would be impracticable to endeavor to arrive at the cost of a smaller unit of locomotive repair, from description of work on daily time card, than the locomotive as a whole, except by timing each individual workman, which practice the committee does not believe would be countenanced by the workmen. Therefore, it is suggested that when it becomes necessary or desirable to determine the cost of any specific unit of locomotive repair a shop order or work order be issued, to which all labor performed in connection with this specific unit of repair be charged and in this way determine its actual cost.

Reducing The Labor Turnover

Discussion of the Advantages of the Employment Department Idea Applied to the Railroad Shop

BY W. C. NISBET

THE widespread movement toward placing employment matters in the hands of a special department has made less headway among railway shops than in industrial concerns perhaps because the latter by reason of their more centralized authority find it easier to get permission to follow courses of action that are new or unusual. There are, however, so many advantages in a centralized employment department that it is worth the while of mechanical department officers to study the possibilities of the scheme as applied to the railroad shop.

The symptom of trouble which has resulted in so many industrial concerns taking the radical step of turning the whole question of personnel over to a special department, is an abnormally high labor turnover and the attendant loss of production, disorganization and resulting increase of costs. Since Magnus Alexander of the General Electric Company made his extensive and careful investigation into the cost of training a new employee there has been a growing recognition that to lose and replace men on skilled or semi-skilled jobs is an exceedingly heavy and to some extent a preventable expense. Mr. Alexander's estimate was that it cost from $50 to $100 to fill the job of one quitting mechanic with another, due to the loss of production during the interim between men and during the breaking in period. The clerical expense of paying off the leaving man and putting on the new employee was also included. The secretary of Fayette R. Plumb, Inc., machine tool manufacturers, stated in an address, that his company had investigated this expense for machinists and found it to be not less than $100 per change.

Such figures are, of course, merely estimates, and the cost will vary within wide limits, depending on many circumstances. A yard laborer who quits may perhaps be replaced with another who at once completely fills the job of his predecessor, but the loss due to changing will vary from this instance to another extreme where the quitting of a valve setter, an air brake man or other skilled hand may slow up the entire shop production before a competent substitute is found and broken in to maintain the pace of the first man.

It is perfectly evident that whether the average cost be $10 or $200 per man quitting, it would be decidedly advantageous from every standpoint to reduce the labor turnover. The question is, how can this turnover be reduced?

One way of attacking any difficult problem is to assign a man to give it constant attention and supervision and thus escape the common fault that what's every one's business is nobody's business.

WHY AN EMPLOYMENT SUPERVISOR?

Assuming that an employment supervisor has been selected, to expect results from such an individual it will be necessary not only to make him responsible for reducing the turnover but also to give him authority to control at least a part of the causes which affect the coming and going of employees. To do this it has been customary to place what is known as hiring and firing in the hands of the employment supervisor, with the belief that better results will thus be gained than by leaving these important functions subject to the personal inclinations of 40 or 50 different foremen. The reasons for taking these duties from the foremen and giving them to the employment supervisor are many. Some of them are as follows:

(1)—Foremen lose much valuable time interviewing applicants for work. It is not infrequent for a foreman with such important responsibilities as supervision of an erecting gang or a rod and motion gang to be called to the office three or four times a day to see different individuals who apply for jobs. It is easy for a foreman thus to lose from a half hour to two hours daily, interviewing applicants, and hence impairing the effectiveness of his supervision.

(2)—All too frequently foremen hire or fire from prejudice, favoritism or on account of religious, lodge or other affiliations. Injustice in such cases is expensive, because the resentment aroused may be passed from one individual to another, until the shop acquires a bad reputation. Furthermore, it is unfortunately not uncommon that when a man desires to quit and applies to the shop office for his time, he is kept hanging around for hours before the foreman appears to give him his clearance. He may have the best reason in the world for leaving; in any case, what kind of a word is he likely to pass around as to the character of that particular shop? A centralized employment department handles such cases promptly and with a settled policy to remain friends if at all possible.

The good will of a business is recognized as a valuable asset. Is not the good will that some shops enjoy through friendly and just dealing an equally valuable asset?

(3)—Foremen often "give a man his time" because there is no more work for him in that particular department, when in another department the man might be needed and fit in exactly. The employment department offers an agency for conveniently effecting such transfers.

(4)—Most foremen have not the aptitude, time or opportunity for hunting up likely candidates, filling out their applications and maintaining records of workmen. As to the latter it is often found that comprehensive records showing the education, training and experience of those at work is a prolific source of information leading to transfers of laborers and other non-skilled men to better paid positions.

(5)—It is important to know why men quit, what departments they leave in largest numbers, what types or trades are most affected, etc. From such figures intelligent conclusions may replace guesses and proper steps be taken to cure or remedy such evils as become evident.

(6)—As we come to recognize that a competent workman is potentially of far greater value than one who is incompetent, it becomes increasingly important to take every means to select the more competent individuals. It is far easier to appoint one person as an employment supervisor and train him to make intelligent selection of applicants than to trust this most important function to scores of foremen each of varying capacity, all of whom are engrossed with a multitude of other duties.

RELATION OF EMPLOYMENT SUPERVISOR TO FOREMEN

In some plants using an employment supervisor the foremen have been notified that they might on cause dismiss a workman from their department but not from the plant. A man thus dismissed is turned back to the employment department for disposition. He may be discharged, but if let off for lack of work or dismissed by the foreman for trifling cause he may be transferred to another department with the proper kind of plain talk as to the conduct which will be expected of him in the future. Other plants allow the foremen to fire men, but require a written notice to the employment department three or more days before the dismissal is effected. This prevents hasty action and discourages the foreman from acting without good cause.

In hiring men the employment supervisor usually receives a form from the foreman stating that he is in need of a certain number of men, as radial drill hands, erecting gang men, laborers, etc., as the case may be. The supervisor selects from applicants, in person, on file or by advertising for the number required, but they are not actually hired until the foreman accepts them. He may reject them if he wishes, though in practice the employment supervisor should and generally does work in such close touch with the foremen that he will know the type the latter desires and will not refer men to the foremen unless they are likely to be acceptable.

If it is conceded that the man problem is in a way the largest single problem in industry, it appears only reasonable to spend considerable time and money in studying it and endeavoring to improve the present situation. For practically every machine there is a man who controls or at least affects the quality and quantity of output. His aptitude, training, experience, energy, regularity of attendance, even his frame of mind, are all variables which in some degree might be improved or corrected if proper provision were made to that end.

For a long time rigid specifications and careful inspections have been common in buying materials and machines. On the other hand, many of our workmen have been hired almost at a glance, without even the most elementary scrutinizing of credentials, experience or fitness. Does this not have a bearing on the fearful procession of incompetents and misplaced individuals who are today passing through our shops?

Of course, the answer will be made that labor shortage, high wages in munition plants, army drafts and similar causes have been the reason for high labor turnover and the placing of incompetents. Naturally these causes have had a great effect, but in many plants it had been recognized even before the war that the former methods of hiring and firing and handling workmen might be improved upon.

DUTIES OF THE EMPLOYMENT DEPARTMENT

Aside from hiring and firing there are many other duties that can be performed by an employment department to better advantage than by the already overburdened foremen. Some of these are to arrange for the physical examination, maintain proper individual records, investigate references and look into absenteeism and tardiness. The timekeeper's department no doubt has a record of the latter, but they are occupied with their regular duties and do not usually go into causes or act to prevent recurrence. The foreman generally knows of the cases, and is sorely tried by the absence of important workers, but his common remedy of angrily "bawling out" the offenders, or perhaps merely a sour look when men are scarce, seldom goes to the root of the matter. Besides, a foreman might well be freed from this task to have more time for others of more importance, such as planning his work, arranging for material, noting quantity and quality of production, instructing the beginners and in general keeping things in motion.

The employment department can listen to complaints. Some men satisfy themselves simply by airing their troubles. This may keep them away from the grievance committee.

Modern business is a cold proposition at best, and it is too frequently forgotten that the workman has human problems of his own and often has a natural inclination to ask advice at the shop where he earns his living and spends most of his waking hours. The foreman of today is forced by press of business to discourage this, and even if he does not there is little opportunity to tell domestic troubles beside a steam hammer, a forging machine or an air riveter.

The person selected for the position of employment supervisor should have rather more of the milk of human kindness in his makeup than is common, and should also be able to speak some of the more common foreign languages used by the workers. In a case where many of the workers were Mexicans an employment supervisor was selected who had lived in Mexico and who had considerable sympathy as well as understanding for the workers. The improvement in turnover was immediate, due as far as could be seen to the substitution of a little humanity for the former cold business dealing with difficulties unexplained and misunderstood.

We all know the foreigner who smiles and says "Yes, yes," but understands nothing and quits next week on account of some imaginary trouble. Doubtless the ultimate remedy is to teach these foreigners English, but meanwhile to do business with them this month, and today it is worth while to have one who can speak their language provided they are employed in considerable numbers.

The employment department can arrange for special training. In some shops to the employment supervisor has been delegated the duty of establishing schools to teach the inexperienced how to operate certain machines. In munition plants barbers, waiters, etc., have quickly been made into lathe hands who often became large producers. Railway shops seldom have such continuous production on any one machine, but the same method of intensive teaching could be followed on many kinds of work.

Some employment supervisors have been assigned the job of investigating the effect of hours of labor on fatigue for all the principal shop jobs. The subject of fatigue in industry is dismissed as "high brow" in most circles, but we cannot escape the fact that fixed rest periods have been found to have increased production in certain kinds of work; also that if we ourselves had to wheel pig iron all day we would soon discover that there was a decided relation between hours of labor and fatigue. We should probably declare in favor of the one-hour day. On the other hand, there are many shop jobs in which it would be no physical hardship to work 12 hours.

It is worth while to determine the facts as to the jobs between the very easy and the very hard and standardize rest periods accordingly. It is not sufficient to leave it to piece workers to rest as often as necessary. The lazy are inclined to rest all too frequently if their rate or the manner of checking production will allow it, and the ambitious but deluded will keep going even on heavy work when a five-minute-per-hour rest would produce a greater output.

DESIRABLE QUALITIES OF AN EMPLOYMENT SUPERVISOR

The element most essential in an employment supervisor is probably tact, as he must maintain co-operation between the men, the foremen and the management; next he should be of a friendly, sympathetic nature to develop similar feelings in the men toward the management and finally by natural aptitude, education and training he should develop the ability to judge men.

He should be a first-class man with a high conception of his work, for it is within the possibilities of his job to be of great value to his employers and also necessarily to help the men to improve themselves mentally, physically and financially.

It goes without saying that he should be a man with extensive mechanical and railroad experience in order to recognize the elements of the various jobs which he is called upon to fill so that when interviewing applicants he can instinctively recognize the fitness of the individual for some one of the half-dozen openings he may have at the moment.

SELECTION OF EMPLOYEES

The employment supervisor will develop a certain amount of ability to recognize competent workmen, he will even sooner develop ability to recognize and avoid types harmful in a shop, such as the belligerent ones, the agitators, the intemperate, the drug users, etc. Observation and conversation are very potent in discovering the traits and tendencies of applicants.

Letters of recommendation are seldom valuable but the occasional tip of value makes it worth while to utilize them. Investigation before hiring frequently develops that a man skilled in a certain trade may not be able to follow it in the particular assignment at hand. For example, a carpenter was hired for shipyard work and was assigned to putting up overhead timbers. It happened he was a skilled workman, but had a physical affection such that his back could not stand the overhead work. He asked for another assignment, but was told "that or nothing," and had to quit the yard, though his trade skill was needed in several places in that very yard. The loss of such a man might be avoided by preliminary investigation and proper assignment.

Psychologists like Walter Dill Scott and William Kemble have developed methods of testing applicants, some of which are extremely valuable, and can be applied to shop workers to good effect. Many successful concerns are adopting some part or adaptation of such methods.

There is a deep-seated feeling among many mechanical men that such methods are impractical and, in fact, they often may be. The term "psychological tests" is high sounding, no doubt, but at bottom what is meant is merely a test frequently using the tools of a given trade to allow the applicant to show he can do what is expected of him.

A test for a laborer would be chiefly as to his strength measured on a testing machine, and while strength isn't everything with a laborer, other things being equal, we desire the strong rather than the weak.

As to testing a lathe hand we know that if we led the applicant to a lathe, gave him the steel and a blue print of a knuckle pin and told him to turn it up we could readily tell whether or not he is the mechanic we want. This would be a practical test very desirable where feasible but probably not possible of application if we were selecting one lathe hand from several applicants. Almost the same results would be secured by handing the applicant a cut of a lathe and a print of the same knuckle pin and letting him tell the examiner how he would proceed with the job. The same idea can be developed indefinitely.

As to the selection of desirable employees in general it is worth remembering that while experience and ability are of prime importance, yet we may lose the advantage of his skill if a man is irregular in attendance, careless, lazy or belligerent. These traits can often be detected in advance by a skilful employment supervisor experienced in watching for just such traits. What we hope to avoid by the centralized employment department is by more careful scrutiny to avoid hiring the trouble makers, the incompetent and the otherwise undesirable who would soon quit or have to be let out. We wish to increase the number of steady workers, the men with constantly growing skill.

WHY SOME SHOPS HOLD THEIR MEN

The J. B. Stetson Company, according to an address by one of their officers, has the creditable record that over 69 per cent of their employees have been with the company over five years. Such records, while by no means common, are not the sole possession of this company.

Wages have probably the largest bearing of any one feature, but there are many other elements which hold men to the old job. Where wages are not a disturbing element perhaps the next most important feature is the treatment accorded the men by foremen and others in authority. Harsh, arbitrary or unjust treatment is very effective in driving men away, and, conversely, a friendly, human attitude and the occasional exhibition of sympathy helps to cement the workers to their jobs. Harsh treatment by those in high positions generally is reflected in the way the foremen treat the workmen.

The expectation of promotion or of periodical wage increase, provided such expectations are ultimately realized, are also helpful in holding workmen.

Good living accommodations for families within convenient access of the shop, allow the retention of married men living at home who naturally are more stable than boarders.

Lunch rooms in the shop or adjacent thereto are now common in industrial plants, for it is evident that whether the men go home, resulting in a hurried walk, or whether they bring their lunch and eat cold food, indigestion is encouraged. It has been found that where a committee of the men handles the lunch room there is less complaint than where the company manages it.

The management of certain plant activities by workmen's committees can be extended to good advantage. In some plants a loan society to beat the loan sharks is run by the men with the co-operation of the management. The itch to run something on the part of certain individuals among the men can thus be gratified and their activities on the grievance committee partly or wholly avoided.

Educational classes for the men appeal to those who are ambitious and help to make men more valuable. English classes in particular are helpful, as they at once make it easier for the foremen to communicate orders and instructions to their men. The intensive method of teaching English to the aliens in the draft army might be copied in this connection.

Parking space for bicycles, motorcycles and autos is appreciated by the considerable number using such vehicles.

As an indication of the extent to which some firms operating strictly for profit have gone to get the most from their employees by welfare methods, Montgomery Ward & Company is reported by the Department of Labor to have made tests and found that the low periods of production are at 10 o'clock in the morning and 3 o'clock in the afternoon, and to keep up the workers' energy, hot malted milk is passed around to all at these hours, free of cost. This may sound like a joke when we apply the idea to such husky workers as Polish riveters, forge hands, etc., yet almost any

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ORGANIZATION OF A SHIPYARD SERVICE DEPARTMENT

Manager of the Service Department.

A—Employment division.
- Soliciting and advertising campaign for employees.
- Selection of employees.
- Records of employees.
- Adjusting grievances.
- Transfer to other work.
- Investigation of discharge and voluntary leaving.

B—Health and safety division.
- Physical examination of applicant for employment.
- Treatment of accident cases.
- Free medical advice to employees.
- First aid classes.
- Statistics of accidents and time lost.
- "Safety First" campaign.

C—Welfare work division.
- Restaurant.
- Bulletin boards and special reports.
- Employees' magazine.
- Clubhouse and reading room.
- Recreation and athletics.
- Naturalization assistance.

D—Educational division.
- Apprentices.
- Evening classes.
- Training new employees.
- Special training for certain important trades.
- Co-operation with state and federal agencies.

E—Housing division.
- Construction of new buildings.
- Finding and listing rooms and houses for rent.
- Information bureau.
- Co-operation with board of trade to prevent excessive charges.

such means of keeping up the production of day workers would pay far more than the cost.

The Curtis Publishing Company provides a farm home which employees call their country club and use as such.

The extensive labor department organizations of several of the shipyards is given in the table to show the scope of their activities in the selection and effort to hold employees.

RESULTS OBTAINED BY EMPLOYMENT DEPARTMENTS

Is the outcome of the effort and expense of developing an organization to work on the employment problem worth while?

To help answer this natural and reasonable question there are given below the comparative figures of several companies which have been working with an employment department to improve their turnover and using some or all of the methods mentioned herein, to secure and hold better employees.

The figures are taken from the Annals of the American Academy of Political and Social Science and may be considered as reasonably correct in most cases.

The Saxon Motor Car Company reduced labor turnover 140 per cent in one year. The Semet Solvay Company reduced labor turnover from 120 per cent to 29 per cent. In 1912 the labor turnover of the Plympton Press was 186 per cent; in 1916 it was 13 per cent. The Ford Motor Company has reduced labor turnover from 400 per cent to 23 per cent. The Dennison Manufacturing Company has reduced labor turnover from 68 per cent to 28 per cent.

The Gas Welding of Thin Plates

The Requirements of Thin Work With and Without Use of Rods; The Behavior of Various Metals

BY J. F. SPRINGER*

II.

One of the principal problems connected with the welding of thin plates with the oxy-actylene torch is the control of the temperature to which the plates are brought. There is frequently trouble in preventing overheating of the work, causing part of the weld to melt away and drop out.

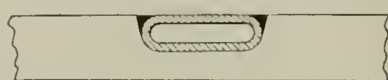
Control of temperature may at times be secured by modifying the angle that the axis of the jet makes with the surface of the seam. When the flame strikes perpendicularly it covers a smaller surface than when it strikes at a sharply acute angle. The same amount of heat is involved in both cases, but the higher temperature will be associated with the greater degree of concentration. For ordinary work, an angle of 45 deg. will be found about right, but in copper welding where there may be trouble in getting enough heat the torch may be used with a greater angle, even up to 90 deg. Aluminum sheets, on the other hand, may need a fairly sharp angle such as 20 or 30 deg. It should be remembered in using an acute angle, however, that the flame will tend to cover a greater part of the seam and will in consequence pre-heat the seam ahead of the zone in which the welding is being done. While the effective temperature will thus be reduced, the time required to secure the molten condition may not be reduced as much as one might expect.

Another method of reducing the effective temperature is to conduct a portion of the heat away from the work. This may be especially useful in welding very thin sheets in joints of the folded type where there may be four thicknesses of very thin metal through which the welding temperature must penetrate without melting the bottom sheet.

There are two ways of accomplishing this purpose. First, the work beneath the seam may be brought into close contact with comparatively cool metal. Thus, the work may be laid upon or even forced down upon a metal slab, which absorbs and conducts away a portion of the heat. The best ordinary metal for this purpose is copper, steel and iron being considerably less effective. The second method is to set a flat tube into the table top so that the work may be brought in contact with its upper surface. The ends of the tube should extend beyond the ends of the table and be of circular section for connection to water supply and discharge pipes. The metal in the tube alone may be sufficient for much of the work, but by turning on the water a further cooling effect is available. Flat under surfaces should be presented by the joints and effective contact with the cooling surface may require the use of clamps. The clamps may also be useful in holding the work against the deformation from expansion of the metal in the seam.

To intensify the heat presents exactly the reverse problem. Sometimes, the character of the metal is such that difficulty is experienced in getting the temperature up to the proper point. Such a condition might well arise with copper and even with metals whose heat conductivity is much less. The work may be steel plates of considerable thickness to be welded in a butt joint with no groove and without the use of a welding rod. The torch is thus called on to pour in heat rapidly enough to raise a considerable thickness of metal to the welding temperature. This situation may be more or less completely provided for (1) by the use of an air space beneath the seam, or (2) by the employment of a solid non-conductor of heat. The air space is provided by a groove or channel in the surface of the table. In the other case the groove may be filled with asbestos, mica or magnesia. If an open groove is used it should not be so wide that the edges of the work will be inadequately supported. The advantage of the solid conductor is that it provides complete support, although the air is probably the better non-conductor.

The greatest difficulties connected with the welding of thin plates are due to unsteadiness of the welder's hands, which results in irregularity in the speed at which the torch advances and in variations in the height of the torch above the work. To overcome these difficulties practice is invaluable, but the workman may find it of considerable assistance in keeping the torch at a uniform height to make use of a horizontal bar as a sliding rest. Or, if preferred, a bracket on wheels or runners may be used as a holder for the torch.



Cross Section of Cooling Tube in the Top of Welding Bed

In some cases it might be advantageous to extend this

*Author of the handbook, "Oxy-Acetylene Torch Practice."

idea a step further. The movement of the work beneath a stationary torch was a fundamental part of the design of the welding machines seen by the writer at the Edison Storage Battery Company's plant some years ago. The seam to be welded was held in a clamp so shaped as to provide access for the torch tip and the welding was done by moving the work along under a stationary torch. This method is especially adapted to cases where a welding rod is not used, the workman thus having both hands available for controlling the work.

WELDING WITHOUT ROD

Welding without the use of a rod is both practicable and advantageous. The object of using the rod is to provide new material to fill the groove and sometimes to increase the thickness of metal at the joint. Both results may be secured without the rod. The purpose of a groove is to make the full thickness of the joint accessible to the torch flame. Several types of joints have already been referred to in which heat penetration is secured by conduction and no groove is provided. Even if extra thickness at the joint is desired in order to offset the loss of strength through overheating, the welding rod may still be dispensed with as suitable ridges may be provided before the welding begins, the melting down of which supplies the extra metal. Where grooves are used, it is often quite possible to form the edges so as to furnish the extra metal required.

There are two principal advantages in omitting the rod and substituting formed edges. (1) The workman has his left hand free, and (2) a uniform amount of new material is supplied all along the joint. On the other hand, there is the disadvantage that the action of the high temperature makes ordinary steel rather brittle and wanting in ductility. By the use of a very pure iron rod, this condition may be remedied. There will, nevertheless, be many cases where the use of a rod will be, at best, of doubtful value and it may well be eliminated.

The edges may be prepared by bending and forming or by upsetting and forming. Where a groove is to be provided, it will, as a rule, hardly be necessary on thin work to bevel at so flat an angle as 45 deg., the standard for general work, the object being to insure a degree of heat penetration sufficient to insure a complete weld. A bevel of 60 deg. or even 80 deg. with the horizontal may be adequate.

MAKING THE WELDS

In welding the simple butt joint where edge is set against edge, particular attention is to be centered upon the necessity of making the high temperature penetrate all the way if the torch is to operate from the one side only, half way or more if the torch is to operate on the work after it has been turned over. If these directions as to penetration are not fully complied with, a defective weld will result. Where the plates are very thin, and too much heat comes from the tip of the torch, the axis of the flame may be directed at a sharp angle to the joint or some type of cooling surface may be used beneath the seam. If necessary, the torch tip may be made to oscillate from side to side across the line of the joint by rotating the tip as it is advanced.

The Edison joint is treated somewhat differently. No oscillation ordinarily will be necessary. The flame is steadily advanced along the line of the joint and is not diverted to one side or the other. The object is simply to melt the two edges and permit the metal to flow together. At times some adjustment of the pressures of the gases may be needed to avoid blowing the molten metal off the edges. The joint is a very simple one to weld, as is well proved by the fact that it has been found practicable to make it with power-driven machines.

In the modified Edison joint where the flanged edges are not deep, more care on the welder's part is needed. The welding may be done as in the original type of joint, or the method employed with the plain butt joint may be used.

In welding the modified plain lap joint where the edges are over lapped and the welding is done by melting off the corners on both sides of the work, and causing them to unite with the adjoining sheets, the torch may be held so that the force of the jet will carry the metal to position. In doing this, however, one must be careful to make sure that the sharp corner into which this metal goes has already been heated. There is probably no one fault more common among welders than that of putting molten metal onto metal not sufficiently heated.

In the type of butt joint where a strip is inserted between the two edges, the work may be handled after the manner used with the plain butt joint. If so, then make sure that the inner white flame is large enough to supply heat on both sides of the projecting strip at one moment. The strip and the edges of the plates are to be melted together.

The folded joint calls for an underlying cooling strip either of simple solid material or a flat tube through which water is kept circulating. With some work it may be necessary that the cooling strip be grooved out on top in order to hug the work along each side of the broad joint.

BEHAVIOR OF VARIOUS METALS

In welding metal plates, it is desirable that the welder be informed with some definiteness and completeness how various commercial metals behave when subjected to the oxy-acetylene torch. It is not only the heat of the flame that acts upon the metal sheets but the active chemical substances in the flame. The gases in the flame are distributed substantially as follows. The acetylene breaks up as it emerges from the torch into hydrogen and gaseous carbon. As far as the brilliant white flame extends there is incandescent carbon, which accounts for the brilliancy of this part of the flame. In short, all through the inner white flame, we have uncombined hydrogen, oxygen and carbon. At the end of the white flame, the carbon burns to carbon monoxide (CO), but the relative amounts of acetylene—the source of the carbon—and oxygen are regulated so that there is not enough oxygen for the conversion of the carbon to carbon dioxide (CO_2). There are two combustible gases beyond the white flame. These are hydrogen and carbon monoxide. Both require oxygen; this they get principally from the surrounding atmosphere with probably a small amount of excess oxygen from the torch.

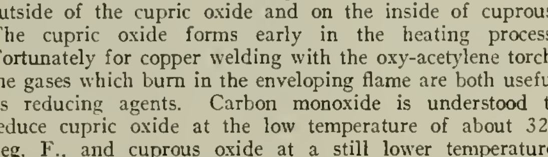
The excessive temperature of the oxy-acetylene flame, far beyond that of the oxy-hydrogen flame, seems to be due to two things: (1) the heat generated by the decomposition, or explosion, of the acetylene and (2) the burning of the gaseous carbon to carbon monoxide. The two sources of heat combined produce the "hot spot" just beyond the end of the small white flame.

A little consideration will show that the possibilities of chemical action are very considerable and in dealing with thin plates this may become a very important matter. If highly heated steel is brought within the white flame it encounters hydrogen, oxygen and gaseous carbon. The first will probably do no harm but both of the others have a damaging effect. Pure oxygen is, in fact, the cutting agent so successfully used in the cutting of hot steel, while carbon acts as a carbonizing—hardening—agent from, say, 1,500 deg. F. up. The lesson for the welder is that any carelessness in handling the torch that results in playing the white flame directly upon hot steel is very apt to damage the material.

The exterior enveloping flame, large in size and moderate in temperature, is beneficial in its action. Consisting as it does of gases avidly seeking oxygen, this flame acts as a protector against the activity of the oxygen of the air. The enveloping flame of the oxy-acetylene torch contains carbon monoxide and hydrogen, both actively uniting with oxygen, and consequently both protectors against it.

The lesson for the welder, especially when the condition and appearance of the work after welding is of importance, is to utilize this flame as far as possible as a protector of the work against oxidation. This lesson applies quite generally to commercial metals other than steel. When at a high temperature nickel is readily oxidized by the atmosphere and copper is probably the most dangerously affected of all. The prevention of the activity of oxygen is possibly the greatest difficulty in the commercial welding of copper.*

Two oxides—cuprous oxide (Cu_2O) and cupric oxide (CuO)—are formed by the oxidation of copper. Oxidation begins when copper is heated in the presence of air to only 365 deg. F. As the heating continues, so does the oxidation. The coloration of the metal varies from rose to brass, to blue green and then to a dark shade. A dark scale forms at a red heat, about 1,100 deg. F., which consists on the outside of the cupric oxide and on the inside of cuprous. The cupric oxide forms early in the heating process. Fortunately for copper welding with the oxy-acetylene torch, the gases which burn in the enveloping flame are both useful as reducing agents. Carbon monoxide is understood to reduce cupric oxide at the low temperature of about 320 deg. F., and cuprous oxide at a still lower temperature, probably about 260 deg. F. Hydrogen reduces both oxides, the cupric at a minimum of about 482 deg. F., and the cuprous at about 297 deg. F. It seems evident, therefore, that the oxy-acetylene torch is not only well fitted for copper welding, but that it is better than the oxy-hydrogen



Arrangement of Clamps on Edison Joint which Use the Outer Flame as a Protection against Oxidation

instrument, the minimum reduction temperatures with carbon monoxide being less than with hydrogen.

It is often possible to provide facilities by which a part of the outer flame may be utilized as a covering of the seam ahead of the point of welding and another part as a covering at the rear. This is what was done in the case of the machine welder used by the Edison Storage Battery Company in welding the longitudinal seam on nickel-plated steel containers. The clamping device which held the work was of such a character that it provided a deep canyon with the seam at the bottom, the canyon being large enough to admit the torch tip and the flame. With this arrangement, the enveloping flame naturally divided itself into two streamers, one lying on the joint ahead of the torch tip and the other on the joint behind the torch tip. The air was thus shut off from the metal all along the joint, until it had cooled down somewhat in the lower temperature of the enveloping flame of the torch. The forward streamre performed a good service by pre-heating the joint before it reached the welding flame, thus lessening the work which that flame had to do.

In all torches an excess of oxygen must be furnished beyond what is theoretically necessary. For one cubic foot of acetylene, only one cubic foot of oxygen is actually used in effecting the chemical combination of carbon monoxide. The excess may run up as high as 35 to 40 per cent, but this indicates a poor torch and oxygen is being wasted. Anything less than 25 per cent, however, may be regarded as reasonable. What becomes of this extra oxygen? Doubtless, some of it after passing through the white flame and past the "hot spot" combines with hydrogen and carbon monoxide in the outer flame. This should be the case when the torch is burning but is not in use. It would seem that this excess oxygen might make more or less trouble when the work is being operated upon. With steel and iron it is probable that the matter is not sufficiently serious to cause much trouble. But with copper and perhaps some other metals, it may be necessary to take measures to overcome the difficulty. One way of doing this is to convert the neutral welding flame into a carbonizing flame.

When the oxy-acetylene inner flame is a brilliant white, is sharply outlined, and consists of a single cone or pencil, it is said to be neutral—that is, there is a balanced condition, and the acetylene is being burnt with the least amount of oxygen possible with that torch. This is the proper condition for welding in general and especially for thin sheets likely to be harmed by either oxygen or carbon. If the oxygen cock is opened wider or the acetylene cock further closed, the neutral flame will be changed to an oxidizing flame. The brilliancy of the cone will be lost and the cone itself will shrink. If, on the contrary, the neutral condition be changed by partially closing the oxygen cock or opening the acetylene cock wider, then a carbonizing flame will result. This means that not enough oxygen is coming through the tip to burn the carbon of the acetylene to carbon monoxide. Consequently, there will be free carbon beyond the usual point. The carbonizing flame may be recognized by noting that the cone is double. For copper plates and for brass plates made from an alloy high in copper, the carbonizing inner flame may be used to make sure that there is no free oxygen in the outer flame.

The non-neutral conditions will occur accidentally, even after a torch has been adjusted to an exact neutral condition. This means that the welder must always be on the alert to correct the adjustment. The neutral flame is so distinct in its appearance that the condition of the flame is very readily determined. The welder operating on thin plates should be eternally on the watch for a change in his flame. Such a change may come about through variations in the pressure back of one of the gases.

Lead may be welded with the oxy-acetylene torch. In the shape of plates, however, the metal requires strict attention because of its low melting point, 621 deg. F. Not only is the melting point low, but the specific heat is also low. This combination means that it requires comparatively a very small amount of heat to attain the melting point. The workman needs to do his work steadily and quickly or else to provide for reduction in the amount or degree of heat. The amount of heat may be cut down by using less pressures or a smaller torch. The temperature may, in effect, be reduced by methods already described. That is, the angle at which the tip is directed onto the work may be flattened, or provisions for cooling may be used. Lead has the advantage of low heat conductivity which permits close localization of the heat in welding.

Nickel behaves a good deal like pure iron. When more than a plating of the metal has to be taken into account, the welding action does not take place so well by merely melting the edges, pressure being needed to assist the metal to unite. The union may then be effected at a temperature below the melting point without the use of a welding rod or a groove at the joint. The welding is, in fact, not a true autogenous process, but from a practical point of view the work may be done advantageously with the aid of the oxy-acetylene torch. The necessary pressure may be applied with a hammer or otherwise.

Tin has a low melting point (449 deg. F.) and a low specific heat. Accordingly, the welder of block tin plates

*For other information on copper welding, see an article by the same author in the *Railway Age Gazette, Mechanical Edition*, for July, 1915, page 367.

must act quickly and steadily. Similar remarks apply to zinc with its melting point at 796 deg. F., and a moderate specific heat. The readiness with which tin conducts heat is fairly slow, while the conductivity of zinc is quite slow. Consequently, with the former a fair localization should be possible and with the latter quite a good one.

The localization of heat may, as already indicated, be promoted by the use of a non-conductor of heat (such as air, asbestos or magnesia) in a groove on the work table underneath the seam. In addition to this, asbestos pasteboard or sheets may be laid on top of the work and brought up close to the seam on both sides of the joint.

Autogenous Welding at Albuquerque

Burned or Cracked Sheets and Tubes Repaired by Gas or Electric Welding; Welding of Flue Beads

BY H. LOUIS HAHN

The problem of efficiency and economically welding locomotive parts has resulted in the development of some interesting methods in the Albuquerque Shops of the Santa Fe System.

The method of applying two new side sheets and a three-quarter door sheet is shown in Fig. 1. The back end of the side sheet and each side of the door sheet are turned at an angle of 45 degrees. this slight turn being made cold in the clamps, thus eliminating the heating and flanging of the side flanges of the door sheet at the flange fire. The door hole opening is flanged at the fire and the flat sheet then sent to the fitting up floor, the sheets fitted and chipped to a 3/16-in. bevel opening as shown and the welding completed by using a gas torch. This makes a very neat job.

Fig. 2 shows a method of preparing side sheets along a

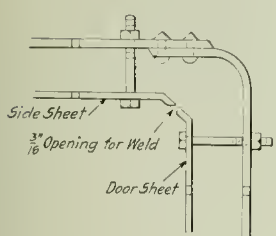


Fig. 1

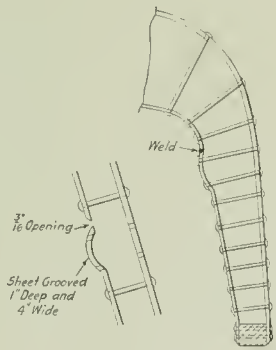


Fig. 2

horizontal seam to compensate for the contraction of cooling welds. The side sheets are laid out, sheared, punched and chipped in the usual manner and are then sent to the blacksmith shop, where a large steam hammer, fitted with a concave die and swedge to suit, is used to put the roll in the sheet as shown. The roll is put in the sheet for the entire length, except at the ends just below top edge to be welded. The ends at the door sheet and flue sheet are left flat for a distance of four inches.

In some cases staybolts are applied before welding the horizontal seam, in others the staybolts and rivets are applied before welding, but in most cases the sheets are applied with a temporary fitting using bolts. The welding is done with a gas torch. No difficulty is experienced from contraction of cooling welds as the roll in the sheet relieves the strains. The same method is also used for the horizontal seams of the three-quarter door sheet when the seam is a sufficient distance above the firedoor opening.

Fig. 3 shows the method of fitting a full or a three-quarter door sheet when old side sheets or the crown sheet are not removed. The portion of the old side sheet containing rivet holes is removed as shown at *B* and a 45-deg. bevel chipped on the sheet. The door sheet is fitted in the regular manner, allowing the surplus flange to lap over the side sheets. The flange is then scribed or marked even with the edge of the side sheet, the door sheet removed and the surplus flange chipped or punched off. The door sheet is then reapplied

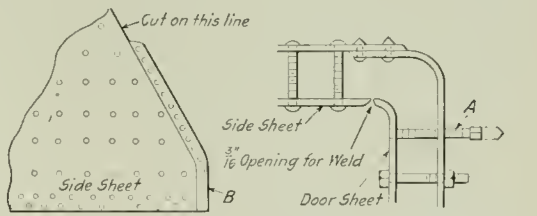


Fig. 3—Welding New Door Sheet to Old Side and Crown Sheets

and the edge of the flange set out 3/8 in. all around to make it flush with the side sheet. The edge of the flange of the door sheet is then chipped bevel for welding. Enough staybolts *A* are applied in holes in the outside sheet and screwed against the door sheet to push the latter into position to allow a 3/16-in. opening for welding. Bolts are applied between the staybolts, and loosened as welding progresses.

Fig. 4 shows the method of repairing cracks in side sheets

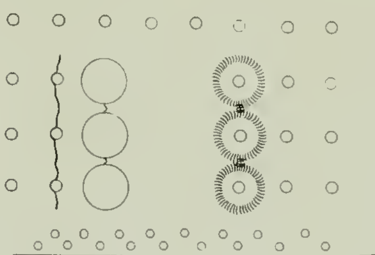


Fig. 4—Repairing Cracks in Door or Side Sheets

and door sheets where there are a small number of cracks and removal of the sheet is not justified.

The staybolts are removed and 3 1/8-in. sunflower plugs applied in the sheet as shown. The crack between the plugs is then chipped out to a 90-deg. opening and a space 1/2 in. wide, 1/4 in. on the plug and 1/4 in. on the sheet is thoroughly worked with a roughing tool in an air chipping hammer to remove all scale. The cracks and roughed edges of the plugs and sheet are then electric welded, using a metallic electrode.

After the patches, sheets and rivets are applied the calking edges of the side, door and flue sheets are welded to the mudring for a distance of eight inches each way from the corner, using an electric metal electrode process.

On old fireboxes, where it is desired to run a defective riveted seam until the regular shopping period, the seam is chipped clean, and the roughing tool used on rivet heads, the seam between the heads, the calking edge and on the sheet for a distance of ½ in. beyond the calking edge. The entire surface is cleaned and roughed and then covered with a layer of added metal about 2½ in. wide, using electric metal electrode process.

Cracks in door hole knuckles are V'd out and electric welded when they are less than two inches in length. For a door hole knuckle having a number of cracks which are over two inches in length a door collar is applied and gas welded. When welding cracks in fireboxes by the electric arc method a live steam line is always inserted in the water space at the mudring to bring the sheets to a good warm temperature before welding, thus prolonging the life of the weld in service.

All firebox door hole flanges are lapped over the backhead door hole flanges the regulation distance for applying rivets, the flanges fitted tight, and after the edges have been beveled as for calking the calking edge is welded to the backhead sheet, no rivets being applied. Should this weld leak at an outside division point where no welding facilities are available holes may be drilled, patchbolts applied and the door hole flange chipped and calked in the regular manner.

Flue beads are welded to the back flue sheet. The flues are applied in the regular manner and the engine taken out

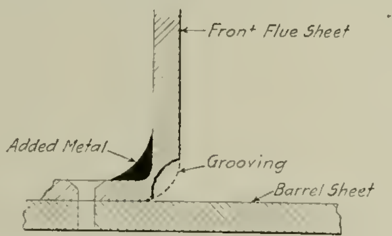


Fig. 5—Repairing Grooved Tube Sheet Knuckle

on its break-in trip in order to boil and burn off all oil and grease on and under the beads, after which the beads are sandblasted and welded to the back flue sheet.

In order to educate electric welders to become flue welders the writer prepares old tube sheets removed from fireboxes by rolling old tube ends about three inches or four inches long in all the holes, beading them in the usual manner. The sheet is then conveniently placed for the welder to practice on and after welding about one thousand of these experimental tube ends he is ready to go in a firebox and start welding regular tube beads.

No patches are applied to the firebox side or door sheets except slip patches at mudring corners, which are gas welded. Crown sheets are patched when they become defective under the T-bars. After the patch on the crown sheet is fitted up ready to weld it is stayed in position by the use of "strongbacks" made of two pieces of ¾-in. by 5-in. flat iron riveted together with a space between them to insert fitting up bolts. These are placed on the top of the crown sheet edgeways and are used to line up the new patch and the old sheet. They are kept in position until after the welding of the patch seam is completed. The gas torch is used on this job.

Grooving of the knuckles of front tube sheets adjacent to the barrel sheets is a common defect and is remedied as shown in Fig. 5. The flange rivets adjacent to the grooved portion of the tube sheet are removed and the fire side of the knuckle of the flange is built up until the thickness equals the original thickness of the sheet, using a gas torch. The flange is then heated, fitted tight and rivets reapplied. This method avoids the removal of tube sheets which otherwise would have to be renewed.

Fig. 6 at *A* shows a defective top tube sheet with the knuckles removed. The sheet is cut across in a straight line through the center of the horizontal bridges in the fourth row from the top. A new patch is flanged and fitted in

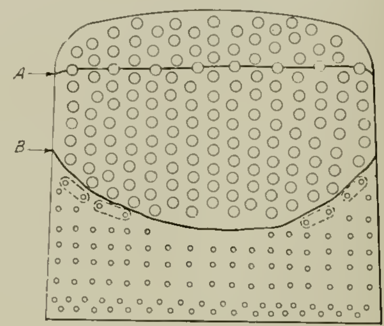


Fig. 6—Patching of Tube Sheets

position and a 3/16-in. opening is beveled and gas welded. After the welding is completed the tube holes adjacent to the weld are reamed to proper size.

The method of removing the tube area of the tube sheet when applying a superheater to a saturated engine is shown at *B*, Fig. 6. The tube sheet is cut across below the tube holes and the new top half flanged and fitted in place, leaving a 3/16-in. beveled opening across the bottom. Care is taken to have the ends of the old and new side flange butt tightly together so that the contraction of the cooling weld across the sheet will not pull the new sheet down from the top corners. After the cross weld is completed and cold, the ends of the side flanges are chipped bevel with a 3/16-in. opening and the welding completed.

In a firebox recently turned out for service by the writer there were two side sheets, one door sheet, one tube sheet patch on the top knuckle, one crown sheet patch under the T-bars and a door hole lap seam, all gas welded, making a total of 50 ft. 2 in. of welded seams in this one firebox.

In the tank department many economies are effected by autogenous welding. A method of building up worn faces of spring pocket castings is shown in Fig. 7, a new wearing face, formed of boiler plate, being electric welded as shown.

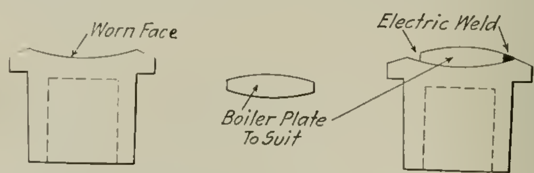
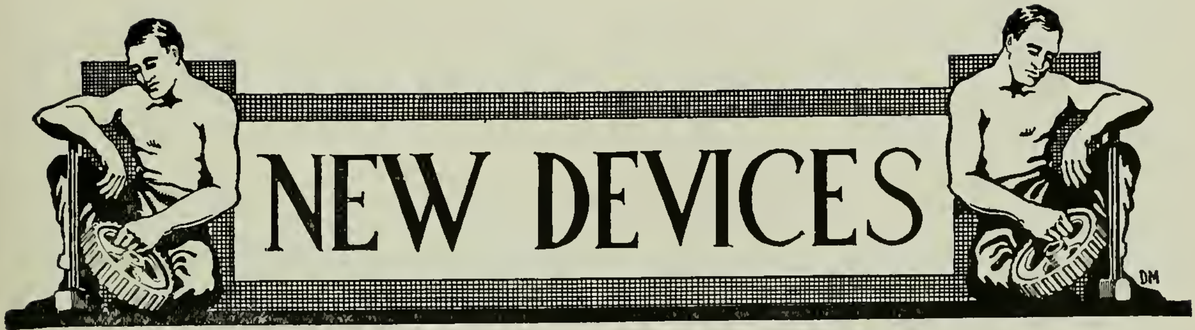


Fig. 7—Renewing Face of Spring Pocket

On castings where the wear is not enough to require the application of a plate the worn portion is built up by applying the metal electrode direct to casting. All castings are uniformly heated to a black heat before welding. This method is more expensive than machining off the face of the chafing casting to a new wearing surface, but constant machining soon causes scrapping of a casting, while the welding method saves it for further use.

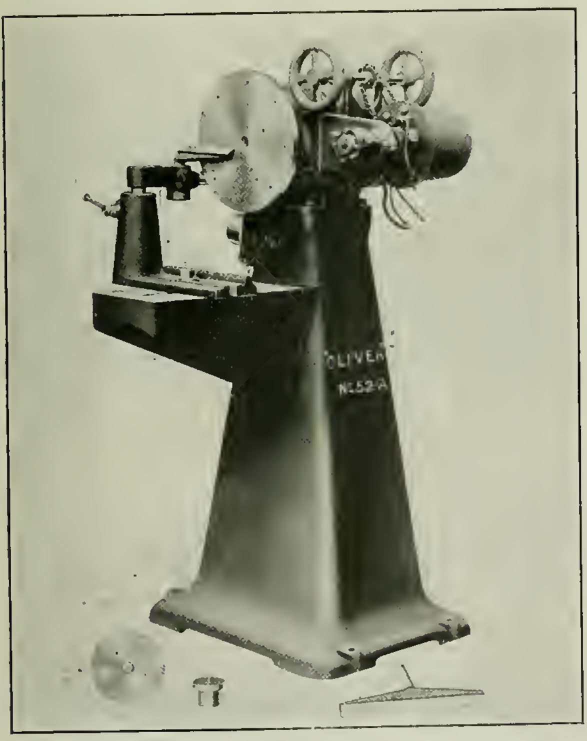
Drawbar pin holes in draw castings on tanks when worn out of round are built up where worn, using the metal electrode, and then rose reamed to the proper diameter. Coupler shanks and coupler carrier plates are reinforced where worn by using the electric arc welding process.



OLIVER MOTOR HEAD FACE LATHE

A face lathe in the head of which the driving motor is incorporated has been placed on the market by the Oliver Machinery Company, Grand Rapids, Mich. The machine has a swing of 24 in. over the bracket, and 20 in. over the rest socket. It will turn work up to 12 in. wide by 20 in. in diameter, or 6 in. wide by 24 in. in diameter, and is a particularly useful tool for pattern shop work.

The machine is entirely self-contained. The motor head, the controller or switch and the rests are mounted on the floor column, making the machine especially adaptable as a portable tool. All electric parts are totally enclosed and dust-proof. The equipment of the machine includes a 16-in. tool rest with an offset holder, one right-angle rest, one 6-in. and one 12-in. face plate and one 2¼-in. screw chuck.



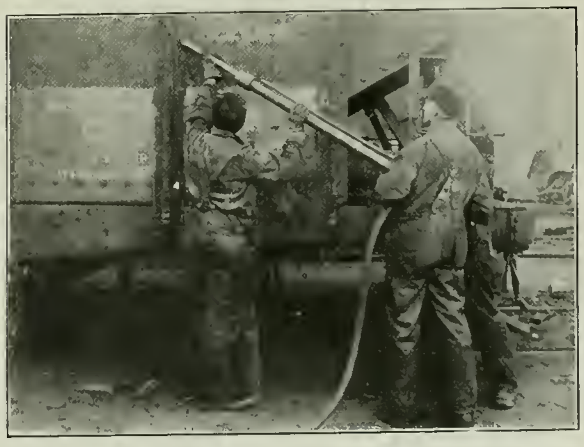
Motor Head Face Lathe Fitted With Alternating Current Motor

The machine is fitted with either an alternating current or direct current motor, the illustration showing the rear view of the alternating current machine with the speed controller attached to the head. The alternating current motor head will run at 800 to 3,500 r. p. m., the speed being controlled by handwheels governing a self-contained controller. The alternating current motor is of the single-phase series-compensated type and will operate on any single or polyphase circuit of proper voltage. It will operate satisfactorily on any frequency from 25 to 60 cycles. The direct current motor head operates from 600 to 3,000 r. p. m. the controller in this case being mounted on the side of the floor column.

The armature or rotor shaft of the motor constitutes the headstock spindle of the machine. This spindle is of steel tubing 1¼ in. in diameter and has a ½-in. hole throughout its entire length to facilitate the removal of centers. The inside end is threaded for face plates and bored out to receive No. 2 Morse taper shanks. The outside end carries a handwheel for holding the spindle while removing the face plates, for turning the spindle by hand when making adjustments, or for quickly stopping the motor. When rear end turning is desired the handwheel may be replaced by a face plate.

A PNEUMATIC RIVET CUTTER

The increase in the amount of steel car repairing has created a need for a tool that will cut rivets quickly and cheaply. Knocking the heads off with a sledge hammer and set is hard work and the pneumatic hammer cannot be used satisfactorily unless the rivets can be reached easily. A tool especially designed for rivet cutting is now being made by the Rice Manufacturing Company, Indianapolis, Ind., known as the Red Devil rivet cutter. By its use it is claimed that ⅞-in. or 1-in. rivets can be cut with from three to five blows and 1¼-in. rivets in 10 seconds.



Pneumatic Rivet Cutter Especially Adapted for Use on Steel Cars

The device consists of a cold drawn seamless tube about 5 ft. long with suitable fittings hydraulically pressed into each end. The rear end is fitted with a valve by means of which air is admitted into the tubes behind the plunger while it exhausts from the forward end into a rubber by-pass. By giving the valve a quarter turn air may be admitted into the by-pass at the forward end of the tube and exhausted from the rear. At the forward end there is a bushing designed to provide a fit for the end of the chisel bar. Inside the tube there is a plunger ground to fit with sufficient clearance to allow easy movement with a minimum amount of air leakage.

As shown in the photograph three men are required to operate the cutter. One stands at the forward end to guide the chisel while two carry the rear end by means of suitable handles, one of them manipulating the valve lever. After a little practice the workmen can operate the cutter either rapidly or slowly and can strike either heavy or light blows. Springs in each end of the tubes absorb the shock of the plunger so that it is not difficult to hold the device while in use. The best results are secured with an air pressure of 90 lb. per sq. in., although if desired the rivet cutter can be used with pressures as low as 40 lb. The total weight of the device in working order is 65 lb. and the total length is 58 in. Under average conditions three men operating this tool are said to cut from 25 to 33 times as many rivets as they could cut in the same time by hand. A smaller tool known as the Baby Devil is manufactured by the same company for use on rivets of 5/8 in. diameter and less. This machine is handled by two men instead of three.

SEMINOLE TOOL STEEL

Considerable thought has been given to the development of tool steels and great improvement has resulted from experiments with numerous alloys, but it has been characteristic of such steels that increased hardness resulted in an increased

Fig. 1—Seminole Steel Chisel Driven Through a 35 Per Cent Carbon Steel Block

brittleness and consequent loss of strength. This is a most important factor in chisel steel, which is subjected to sudden and severe stress from the blows of a hammer.

A tool steel having some unusual properties has been developed by the Ludlum Steel Company, Watervliet, N. Y., which has been given the trade name, "Seminole." It can be made so hard that it will cut glass, but will bend without fracture. Some of the possibilities of this steel are illustrated in Fig. 2, showing a piece 1/4 in. by 1/16 in. that is extremely hard but has been bent so that the loop is less than 1 1/2 in. in diameter. Fig. 3 shows a piece of the steel

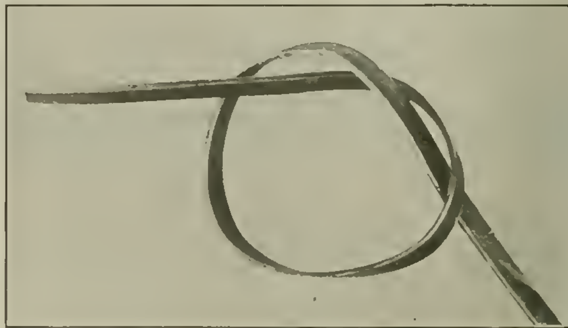


Fig. 2—A 1/4-in. X 1/16-in. Piece of Seminole Steel

drawn to a point and driven three times through a low carbon steel bar without breaking. Fig. 4 shows a chisel that was driven through a block of .35 per cent carbon steel, bent over and straightened several times without breaking, and was then found hard enough to scratch glass. Fig. 1 shows a chisel of this steel driven through a .35 per cent carbon steel

Fig. 3—Low Carbon Steel Bar Pierced by Chisel-Steel Spike

slab without bending the chisel or damage to its edge. All of these tests were made with tools and material cold.

This steel can be satisfactorily hardened in temperatures ranging from 1,650 to 1,950 deg. F., but the preferable range is considered to lie between 1,750 and 1,800 deg. After heating, the steel is quenched in oil and then slightly drawn. The drawing increases the toughness of the metal

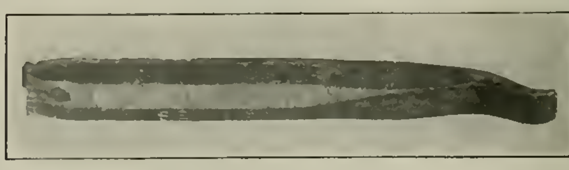


Fig. 4—Seminole Steel Chisel, Bent Several Times After Driving Through Steel Bar

without decreasing the hardness. Another desirable quality of this steel is that it does not sliver, thus eliminating a frequent cause of injury to users.

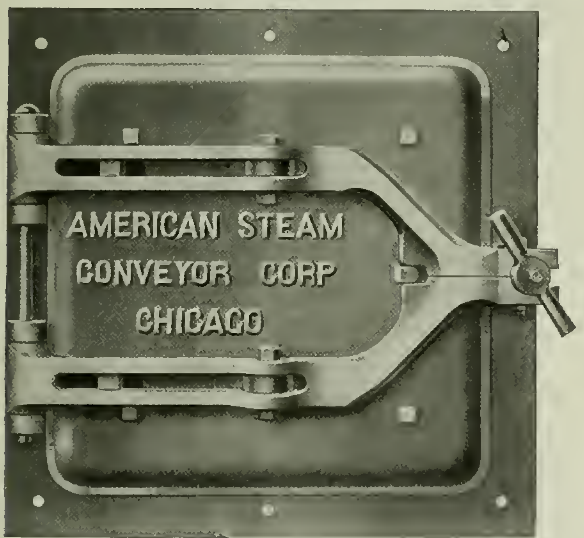
Photomicrographs taken at 400 magnifications show a very fine structure which tests have indicated is highly homogeneous.

AIRTIGHT ASH PIT DOOR FOR STATIONARY BOILERS

A perfectly tight ash pit door is essential to prevent combustion in the ash pit and also in preventing excess air from entering the firebox through some types of stokers. Plant economy and ease in handling ashes are features which should be carefully considered in choosing doors for the ash pits of power houses.

The American Steam Conveyor Corporation of Chicago and New York, specializing in all forms of ash disposal equipment is manufacturing the American ash pit door which has been produced as the result of careful tests and study, covering all points essential to successful operation and durability.

Experience has shown that an ash pit door should not be larger than is necessary to allow easy removal of ashes from the pit, as it is difficult to prevent a large door warping and thus leaking air and it is also too heavy to be handled easily. A 24-in. by 36-in. door is recommended as ample in size for the largest pit. Three other sizes, 18 in. by 18 in., 22 in.



American Airtight Ash Pit Door with Hinges Arranged to Produce Uniform Pressure on the Frame

by 26 in., and 24 in. by 24 in. are also built of the same general design.

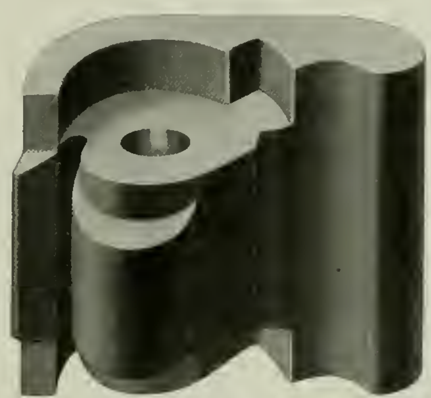
The door frame is of cast iron of ample strength for all conditions. It is of angle section, fits well back into the setting and is easily fastened into the pit wall by four bolts, one in each corner. The bearing surface is carefully machined. The hinge and locking lugs are cast on the frame and are of ample strength to meet the hard usage to which ash pit doors are subjected.

The door itself is of heavy cast iron and is provided with a heavy ventilated cast iron liner to prevent contact with the hot ashes and consequent warping. The bearing surface of the door is also carefully machined to make an airtight joint with the frame. Two hinges of the floating type with hinge bars pivoted to the frame carry the door at the center where it is pivoted to the bars. This gives a perfectly distributed pressure on the door and keeps a tight joint at all points with no possibility of a clinker in the corner of the frame opening, breaking or bending the door by a wedge action and also allows the door to be swung entirely out of the operator's way.

The door is easily, quickly and tightly locked by means of wing nuts at the end of the hinge bars, two locks being used for the 24-in. by 36-in. door and one lock for smaller sizes.

REX EMERGENCY KNUCKLE

It has become common practice on American railroads to carry in cabooses so-called emergency knuckles. These devices can be applied in place of any standard knuckle in case of breakage, and are stronger than chains and easier to apply. The National Car Equipment Company, Chicago, is now manufacturing a new device of this type which is known as the Rex emergency knuckle. When applied it is held in place by the knuckle pin and by a rib extending

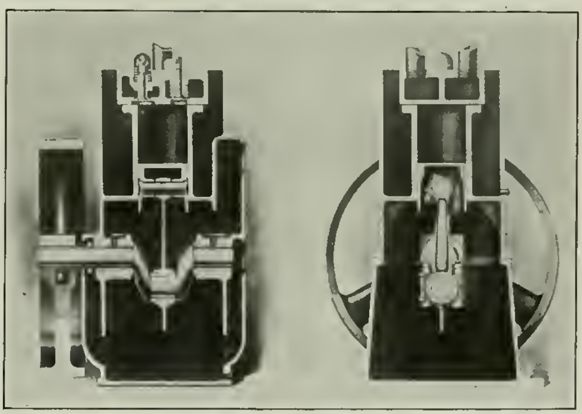


Emergency Knuckle That Can Be Applied Without Removing Knuckle Lock

over the side wall of the coupler. This makes it unnecessary to remove the locking device from the coupler before applying the emergency knuckle. The Rex emergency knuckle has the further advantages of being light and easy to apply, and its use does not increase the distance between cars. It has already been adopted by several important railroad systems.

SMALL AIR COMPRESSORS

To meet the need of a small air compressor the Ingersoll-Rand Company, New York, placed its "Imperial Fourteen Compressor" on the market. These compressors are of



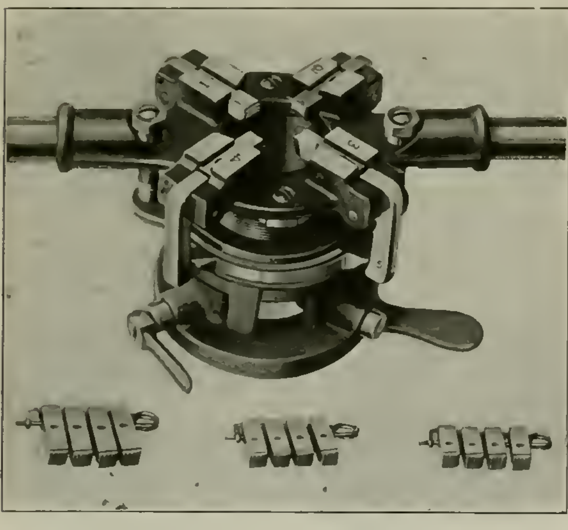
Sectional Views of Ingersoll-Rand Small Air Compressor

simple, rugged construction and the design is very similar to that of an automobile engine, having the same type of drop forged crank shaft and connecting rod, die cast, renewable bearings, and automatic splash lubrication system. They are made in four sizes, ranging in capacity from 3 to 45 cu. ft. per minute at pressures up to 100 lb. per sq. in. The small compressors may be used for pressure up to 200 lb. per sq. in. by using a slightly increased horsepower. The machines are of the single acting, belt driven, vertical type, and may be bolted to any solid flooring, but for permanent installation a concrete foundation is preferable. The smallest size is built with an air cooled cylinder for intermittent service, or with a water cooled cylinder of the reservoir type for continuous operation. The larger sizes are built only with water cooled cylinders employing the reservoir jacket system, except for the largest size, for which a closed jacket for connection to a pressure system is optional.

In the reservoir jacket system both the cylinder barrel and head are cooled, and the jacket is designed to hold sufficient water to operate for a period of 10 hours with a single filling.

RECEDING PIPE THREADERS

A new design of receding pipe threader has recently been developed and placed on the market by the Greenfield Tap and Die Corporation, Greenfield, Mass. This tool is turned on the pipe until the desired length of thread is cut and can then be pulled off without turning back. At the beginning of the operation the chasers cut a full depth thread, and as the work progresses the levers supporting them gradually change their position, permitting the chasers to recede until they have completely withdrawn from the pipe, thus allowing the threader to be pulled off without the loss of time that would be required to unwind from the threads. A single turn of any one of three lugs, conveniently placed, disengages the lead screw so that the head may be lifted and returned to its original position and the trigger reset to begin another cut.



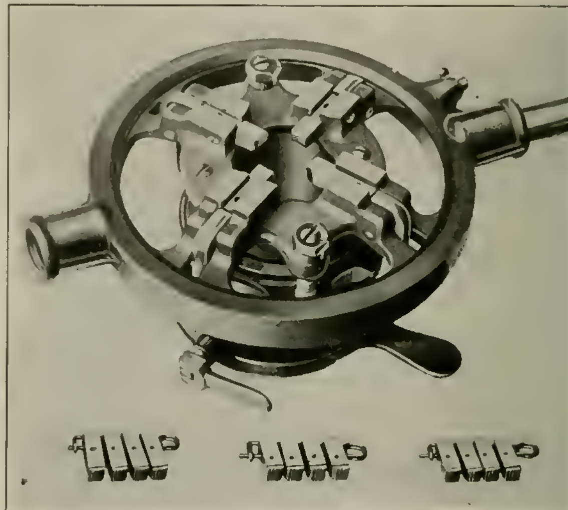
Pipe Threader the Dies of Which Automatically Recede to Permit Removal Without Unscrewing

The chasers are narrow and travel parallel to the thread they are cutting, thus reducing friction to a minimum. They are interchangeable and so made that in case of breakage a single chaser may be replaced and follow or "track" uniformly with the rest of the set. They are also made in sets for each pipe size and with either the Briggs or Whitworth thread.

The lead nut is in three segments, which are self-cleaning so that dirt or chips cannot gather on the lead screw, and both the lead screw and nut can be replaced without returning the tool to the factory. Adjustment for cutting shallow or deep threads is easily made by means of the lock nuts and adjusting rods that project through the head of the threaders.

A three-jawed universal chuck guide is provided, and after the jaws are tightened against the pipe one turn of a grip screw working inside the chuck, tightens it so it will not slip.

For threading pipe in trenches or other places where the space is limited, a threader of similar general design but provided with a ratchet receding mechanism has been developed. The ratchet mechanism is incorporated in the die stock and has two handles, one of which may be detached, thus permitting the tool to swing in a 14-in. circle. This tool can also be used in the same manner as the other receder by disengaging the ratchet.



Ratchet Receding Threader

SELLERS INJECTOR INDICATOR

In the description of the Sellers injector indicator, published on page 218 of the April, 1919, *Railway Mechanical Engineer*, an error was made in the last sentence of the second paragraph. One-half-inch copper pipe is used to connect the upper end of the cylinder with the overflow chamber of the injector instead of ½-in. copper wire as incorrectly stated in the article describing the device.

Exports from Britain.—The British railway supply export figures for the whole year 1918 are given in the Board of Trade returns for December. They are as follows, the corresponding figures for 1917 being given in parentheses. Locomotives, $5,377,435 ($8,147,270); rails, $2,421,000 ($3,452,375); carriages, $2,807,380 ($825,880); wagons, $1,644,055 ($2,215,120); wheels and axles, $1,722,340 ($783,165); tires and axles, $3,098,795 ($2,697,645); chairs and metal sleepers, $820,450 ($368,410); miscellaneous permanent way material, $2,785,165 ($2,472,210); total permanent way, $6,105,475 ($6,319,630). The weight of rails exported was 26,335 tons (38,900 tons), and of chairs and metal sleepers, 10,173 tons (5,650 tons). Of the locomotive exports $147,950 ($1,138,850) in value went to South Africa and $1,237,050 ($882,965) to British India.

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WE GUARANTEE, that of this issue 9,220 copies were printed; that of these 9,220 copies, 7,656 were mailed to regular paid subscribers, 72 were provided for counter and news company sales, 192 were mailed to advertisers, 27 were mailed to employees and correspondents, and 1,273 were provided for new subscriptions, samples, copies lost in the mail and office use, that the total copies printed this year to date were 40,610, an average of 8,122 copies a month.

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W. G. McAdoo, of New York City, former director general of railroads, has been appointed special counsel to the Railroad Administration on matters arising in the state of New York, to serve without pay.

Exports of locomotives in February, 1919, totaled 85 with a value of $2,584,269, as compared with 87 in January, 1919, valued at $3,076,543. Exports of car wheels and axles in the month of February, totaling $541,630, were double those of January, when exports of these commodities were made, which were valued at $278,393. Two hundred and twenty-five passenger cars were exported in February, valued at $130,768, and 583 freight and other cars, which were valued at $957,128.

For the purpose of meeting the emergency caused by the radical curtailment of the machinery of the United States Employment Service because of lack of funds, the Council of National Defense has announced the formation of an Emergency Committee on Employment for Soldiers and Sailors, including representatives of the various government departments. The chairman of the committee is Col. Arthur Woods, and the secretary will be E. H. Greenwood, who has been associated with the Department of Labor in its employment work. A representative of the Railroad Administration probably will be added to the membership of the committee.

The Pennsylvania Railroad is building an 11,000-volt power line from South Altoona to Altoona and is installing at that place the first unit in a centralized power station that will do away with the plants at Twelfth street, Fourth street and Juniata. These plants will be retained only to generate steam for heating and the operation of steam hammers. The installation of the new system, on which work is already well under way, will involve the placing of two 5,000-kw. generators and auxiliary machinery at the new South Altoona plant, the power line of all-steel construction, and sub-stations at South Altoona, Twelfth street, Fourth street and Juniata. At these places transformers will step down the current to the voltage needed to operate at that particular place. The change, which involves the expenditure of many thousands of dollars, will be completed in the early summer. Although the new system is being installed as a matter of economy, it will incidentally be a very material aid in lessening the smoke nuisance in Altoona.

Railroad Y. M. C. A. Campaign

Arrangements for the "Continental Extension Movement" of the Railroad Y. M. C. A., which is to be inaugurated on May 18, have been completed and the slogan "Couple Up" has been adopted. It is significant that the 300 associations in this country will act as a unit in this extension movement. Another important factor is that the railroad men themselves are taking the leadership in the movement, and the secretaries are being utilized largely in an advisory capacity. While efforts will be concentrated at the opening of the campaign to increase the membership, this is only a small part of the extension program. The summer months will be utilized for assimilating the new members and perfecting the general organization of the different branches and then early in the fall there will be a series of campaigns, each lasting one week, and each devoted to stirring up interest and developing plans for the year to cover the various phases of the work. For instance, there will be a religious week, a thrift week, a health and happiness week, educational week and Americanization week. It is expected that a very large number of new members will be drawn into the work and that active work will be carried on among employees who are not now served by the association.

Steel Price Situation

Little progress has been made in carrying into effect the schedule of steel prices announced in these columns last month as the outcome of a conference of the Industrial Board of the Department of Commerce with representatives of the steel industry. A controversy has arisen with Secretary Glass and the Railroad Administration on one side and the Department of Commerce and its Industrial Board on the other, which springs from a difference of understanding as to the function of the board, as well as over the price of steel. The Railroad Administration does not concede that the authority of the board goes so far as the arbitration of the question of prices, but that its function is merely that of a mediator to bring about agreement between the producers and government purchasing departments. The Railroad Administration takes the position that until a price was reached which would be satisfactory to it, the board had failed to accomplish its intended functions and it has never agreed to the schedule as announced. The result is that inasmuch as the Railroad Administration is the largest purchaser of any of the government agencies, the proposed prices have little prospect of becoming established, especially so far as steel rails are concerned.

Members of Thirteenth Engineers Receive French Decoration

On February 22, 1919, thirty-one officers and men of the Thirteenth Engineers were awarded the Croix-de-Guerre. The decorations were presented at Simmeilles-Nettencourt by Colonel Boquet, Director General of Military Transports of the French armies. In bestowing the decorations upon the engineers, Colonel Boquet said in part:

"I am very happy to have been directed to hand today the Croix-de-Guerre, which it has been Marshal Petain's goodwill to award some of you in accordance with the proposals made by Lieut.-Colonel Marchand, Military Commissaire of the Eastern Railroad, and myself.

"These rewards you fully deserve for the untiring zeal and devotion you have shown. * * * I have known the 13th Regiment of American Engineers ever since their arrival in France. I have constantly watched their work and efforts, and I have, better than anyone else, been in a position to appreciate their valor and good spirit."

Those to whom the decoration was presented were:

Colonel N. L. Howard, formerly division superintendent on the Chicago, Burlington & Quincy, at Hannibal, Mo.

Lt. Col. C. E. Whiting, formerly division superintendent on the Chicago, Milwaukee & St. Paul, at Lewistown, Mont.

Major E. Schultz, formerly division master mechanic on the Chicago & North Western, at Chicago.

Captain W. Haberlaw, formerly roadmaster on the Chicago, Rock Island & Pacific, at Rock Island, Ill.

Captain J. W. Kern, formerly supervisor on the Illinois Central at Mounds, Ill.

Lieut. Hugh MacKee.

Lieut. H. Halverson, formerly roadmaster on the Chicago & North Western at Eagle Grove, Iowa.

Lieut. E. E. Deyo, formerly yardmaster on the Chicago Great Western at Oelwein, Iowa.

Lieut. R. Harrisson.
Lieut. L. A. Weary.
Master Engr. F. Williams.
Master Engr. B. Berryhill.
Sergeant L. Face.
Sergeant O. Olsen.
Sergeant H. Lightner.
Sergeant Thomas J. Ross.
Sergeant J. E. Morrell.
Sergeant W. N. MacMahon.
Sergeant A. G. Crozier.
Sergeant W. Dreasher.
Corporal C. T. Barnes.
Corporal W. Lish.
Corporal W. T. Mott.
Corporal M. H. Bootjer.
Private D. C. Steinmeyer.
Private V. Nicholls.
Private G. Tichy.
Private F. Bitte.
Private E. Vondeveld.
Private W. B. Muller.

MEETINGS AND CONVENTIONS

Tool Foremen's Association.—It has been decided to hold the ninth annual convention of the American Railway Tool Foremen's Association at the Hotel Sherman, Chicago, on August 27 to 29, 1919.

Convention of Master Tinners', Coppersmiths' and Pipefitters' Association.—The American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association has announced that the next annual convention will be held on June 2, 3, 4 and 5, 1919, at the Marquette Hotel, St. Louis, Mo. The topics selected for discussion are as follows: Alloys of Soft Metal, George Hofford; Spot Welding in the Railroad Tinshop, A. Paulis; Light Gage Sheet Metals, Charles Borcherdt, chairman, and M. M. Byington; Pipe Threading, Cutting and Lubricating, F. J. Bucholtz, chairman, and J. G. Hunnicutt; Labor Saving Devices, C. E. Knight, chairman, and W. J. Moffatt; Commercial Iron and Steel Pipe and Copper Tubing, T. E. Holderby, chairman, W. E. Jones and J. F. Richards. The officers of the association are: President, W. J. Moffatt (N. Y. C.); first vice-president, G. B. Hofford (M. P.); second vice-president, W. W. Nash (I. C.); third vice-president, T. E. Holderby (C. & O.); secretary-treasurer, O. E. Schlink (C. & O. of Ind.)

Air Brake Association Convention.—The 26th annual convention of the Air Brake Association will open at 9:30 A. M., May 6, at the Hotel Sherman, Chicago, Ill. Frank McManamy, assistant director, division of operation, United States Railroad Administration, has issued a circular to the various regional directors, requesting them to send as many as possible of their air brake men to the convention, and from present indications the attendance this year will be greater than at any previous convention.

The complete list of subjects to be presented is as follows: (1) Air Consumption of Locomotive Auxiliary Devices, by C. H. Weaver and Committee; (2) Air Leakage and Money Wastage Through Failure to Keep Hose Couplings in Standard Gage, by the Manhattan Air Brake Club; (3) Recommended Practice; (4) M. C. B. Air Brake Defect Card; (5) Instructions on Freight Car Brake Maintenance; (6) Holding Standing Trains and Cars on Grades; (7) Damage to Air Brake Equipment by Thawing Plants, by the North West Air Brake Club; (8) Braking Ratio of About 40 Per Cent and Inside Release Valve for Caboose Car, by the North West Air Brake Club; (9) How Can Enginemen and Trainmen Assist in Air Brake Maintenance? (10) A Resumé of the Air Brake Supervisor's Responsibility to the Stores Department, by Montreal Air Brake Club.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 6-8, 1919, Chicago.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention, June 2-5, 1919, Marquette Hotel, St. Louis, Mo.

American Railway Master Mechanics' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention, August 27-29, Hotel Sherman, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. R. McMunn, New York Central, New York, N. Y.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago. Convention May 19-22, 1919, Hotel Sherman, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Convention September 2-5, 1919. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention, May 26-29, Hotel Sherman, Chicago.

Master Car Builders' Association.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 18-21, Atlantic City, N. J.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y.—Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Seretary	Address
Canadian	May 13	....	....	James Powell	P. O. Box 7, St. Lambert, Que.
Central	May 9	Railroad Power Plants	William Olsen	H. D. Vought	95 Liberty Street, New York.
Cincinnati	May 13	Fuel Conservation	D. E. Dick	H. Boutet	101 Carew Building, Cincinnati, O.
New England	May 13	Co-operation and Not Competition is the Life of Trade	George J. Burns	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	May 16	An Evening with Foreign Railway Men	....	H. D. Vought	95 Liberty Street, New York.
Pittsburgh	May 23	....	....	J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	....	....	....	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	May 19	....	....	A. F. Stuebing	750 Transportation Bldg., Chicago.

Personal Mention

GENERAL

M. K. Barnum, assistant to general superintendent maintenance of equipment of the Baltimore & Ohio, with office at Baltimore, Md., has been appointed mechanical engineer for the corporation.

W. F. Connal has been appointed mechanical engineer of the Canadian National Railways, with office at Toronto, Ont., succeeding H. D. Cameron, resigned to enter other service.

J. E. McQuillen, mechanical superintendent of the Gulf, Colorado & Santa Fe, the Fort Worth & Rio Grande, the St. Louis-San Francisco & Texas, the Texas Midland, the International & Great Northern (from Spring to Fort Worth and the Madisonville branch), the Fort Worth Belt, the Fort Worth Union Passenger Station, and the Houston Belt and Terminal, has also been appointed mechanical superintendent of the Fort Worth & Denver, the Wichita Valley, the Missouri, Kansas & Texas (west of Whitesboro), the Wichita Falls & Northwestern, the Abilene & Southern and the Quanah, Acme & Pacific, with headquarters at Galveston, Texas.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

W. J. Ormsby, general foreman in the locomotive department of the Illinois Central, with headquarters at Chicago, has been promoted to master mechanic of the Wisconsin division of the same road, with headquarters at Freeport, Ill., to succeed E. Lawless, deceased.

CAR DEPARTMENT

C. A. Sasse has been appointed divisional car foreman on the Pennsylvania division of the Delaware & Hudson, with headquarters at Carbondale, Pa., succeeding F. S. Ganley, assigned to other duties. Mr. Sasse will report to the master car builder.

OBITUARY

Amos H. Watts, who was master mechanic of the Cincinnati Northern, with office at Van Wert, Ohio, previous to July, 1912, died on March 30, at his home in Walnut Hill, Ohio, at the age of 72.

David M. Perine, special agent on the personal staff of the general superintendent of the New Jersey division of the Pennsylvania Railroad, with headquarters at New York, died on April 22 at Baltimore, Md., while on a business trip in that city. He was born on February 13, 1869, at Baltimore, Md., and entered the service of the Pennsylvania System in May, 1889, as an apprentice at the Mt. Vernon shops of the Northern Central. He subsequently served consecutively as assistant road foreman of engines, assistant master mechanic, assistant engineer of motive power, and master mechanic until April, 1906, when he was promoted to superintendent of motive power of the Northern Central and the Philadelphia & Erie. The following year he was transferred to Pittsburgh on the Western Pennsylvania division, and in January, 1912, was again transferred to the New Jersey division and the West Jersey & Seashore, as superintendent of motive power, remaining in that position until his promotion in June, 1917, as special agent on the personal staff of the general superintendent of the New Jersey division, as above noted.

Supply Trade Notes

The Union Asbestos & Rubber Company of Chicago has moved its general offices from 112 West Adams street, Chicago, to 2834 South Loomis street.

The Standard Railway Equipment Company of New York, Chicago and St. Louis has moved its New York offices from the Singer building to the Equitable Trust building.

On April 1, 1919, the name of the Aspromet Company, Pittsburgh, Pa., manufacturers of asbestos protected metal, was changed to the H. H. Robertson Company.

The Pacific Car & Foundry Company, Seattle, Wash., has expended approximately $400,000 for new buildings, tools and equipment in refitting the car building plants situated at Renton, Wash., and Portland, Ore.

The Interstate Iron & Steel Company of Chicago has opened a branch office at Detroit, Mich., with R. B. Dutch in charge of sales in that territory. Mr. Dutch has been identified with the iron and steel industry for several years.

A. M. Mueller, manager of the St. Louis branch of Joseph T. Ryerson & Son of Chicago, has been promoted to general manager of sales, in which capacity he will have charge of all warehouse and mill products for all territory west of Pittsburgh. He was born at Plymouth, Ind., on July 30, 1874, and received his education in the public schools at that place. His business career dates back to 1899 when he first entered the employ of Joseph T. Ryerson & Son as a clerk in the credit and cashier department. During this period he served successively as traveling salesman, Texas representative for three years and manager of the New York and Minneapolis offices until 1911, when he was appointed assistant manager of sales. Later he went to St. Louis, Mo., as manager of the Ryerson-Hagar plant, being recalled at the end of three years to handle the sales at the main plant at Chicago.

A. M. Mueller

C. M. Schramm, chief clerk to the general mechanical superintendent of the Chicago, Rock Island & Pacific, with headquarters at Chicago, has been appointed assistant to the vice-president of the Vapor Car Heating Company at Chicago.

The Chicago Pneumatic Tool Company has discontinued its branch office at Wichita, Kan., and has transferred the stock from that place to Eldorado, Kan., where an office and warehouse have been established. A new office has also been opened by the company at Tulsa, Okla.

The Firth Sterling Steel Company, McKeesport, Pa., announces the removal of its New York and Boston warehouses to new quarters. The New York warehouse will henceforth be at 310 Hudson street and the Boston warehouse at 35

Oliver street. The latter was previously occupied by the company from 1873 to 1914.

The American Blower Company, Detroit, Mich., has purchased a plot of ground containing approximately 15 acres upon which it intends to build a new plant. Plans are now being prepared for the construction of a foundry on which work will be started in the near future.

F. J. Foley has been appointed general sales agent of the Railway Steel-Spring Company, with headquarters at New York. Mr. Foley's connection with the company dates from its organization in 1902. For the past eight years he has occupied the position of general superintendent.

The Chicago branch of the General Asbestos & Rubber Company, Charleston, S. C., has recently moved into new quarters at 14 North Franklin street, Chicago, the rapid growth of the business in Garco asbestos products having made the old quarters at 106 West Lake street inadequate.

Frederick G. Zimmerman, assistant secretary of Harry Vissering & Company and the Okadee Company of Chicago, has been appointed secretary, to succeed Marshall E. Keig, who has resigned to accept the office of assistant to the president of the Consumers Company at Chicago.

Frank Walsh Haskell, president of the Carborundum Company, Niagara Falls, N. Y., died April 2 at his winter home at Daytona, Fla. Mr. Haskell was born in Brooklyn, New York, in 1861, and was educated in the schools there and in Bloomfield, N. J. He was for a time in railroad service as a rodman in the engineer corps, which laid out the Chicago, St. Paul, Minneapolis & Omaha. In 1885 he moved to Pittsburgh and there affiliated himself with Henry C. Frick as secretary and treasurer of the Southwest Connelsville Coke Company, owned jointly by the Frick and Illinois Steel Companies. In 1897 he moved to Niagara Falls, representing the Mellon interests of Pittsburgh, and becoming president of the Carborundum Company, then in its infancy. This company under his leadership became the greatest abrasive manufacturing concern in the world. It is not generally known that at the request of H. C. Frick and E. H. Harriman in 1905 Mr. Haskell made the investigation of the Equitable Life Assurance Society, which later brought before the public the disclosure resulting in the entire change in the method of life insurance business in the United States. The Armstrong and Hughes Investigating Committees, so-called, were the subsequent results, their facts being largely based on Mr. Haskell's accomplishment.

F. W. Haskell

Ensign Donald Walker, U. S. Naval Aviation Corps, died in the Naval Hospital at Key West, Fla., April 7, as the result of a fall of an aeroplane, of which he was the pilot, at Miami, Fla., on April 1. He was the son of Edmund H. Walker, vice-president of the Standard Coupler Company and president of the Railway Supply Manufacturers' Association. Ensign Walker was a student at Yale University when he entered the aviation service last year. He was 21 years of age.

The Bailey Meter Company on May 1 moved its main office and factory from Boston, Mass., to Cleveland, Ohio. The Boston office, with H. D. Fisher as manager, is being retained to handle sales and engineering service work in the New England district. For the present, New York and Philadelphia districts will be covered from this office and all other districts will be covered from Cleveland.

The Liberty Steel Products Company, Inc., announces the appointment of J. M. Borrowdale as sales representative in the railroad department, with office at 1901 McCormick building, Chicago. Mr. Borrowdale was formerly superintendent of the car department of the Illinois Central and for the past two years was connected with the H. W. Johns-Manville Company, New York, as sales representative in their railroad department.

D. P. Lamoreux, general manager of the Pratt & Letchworth Company, Ltd., Brantford, Ont., has been elected vice-president of the Canadian Car & Foundry Company, Ltd. Mr. Lamoreux has been connected with the Pratt & Letchworth Company since October, 1916. He was born in Mayville, Wis., December 12, 1873. He received his education at the University of Wisconsin, where he took a course in civil engineering as a member of the class of 1895. After leaving college he spent two years in the maintenance department of the Milwaukee Northern Railway, and the California-Oregon Railway, and for the following three years was private secretary to the commissioner of the general land office at Washington, D. C. In 1900 he became associated with the Beaver Dam Malleable Iron Company and worked his way up through that organization until in 1913, when he left to take up another position, he was the company's general manager. During this period, also, he was on the executive and legislative committees of the Wisconsin Manufacturers' Association and for three years of this time, was also regent of the University of Wisconsin. In 1913 he entered the railway supply business in Chicago, and was connected with the Cleveland Steel Company and the Trumbull Steel Company. He became connected with the Pratt & Letchworth Company in November, 1916, as general manager.

D. P. Lamoreux

William H. Basse has been appointed manager of the Detroit, Mich., plant of the Joseph T. Ryerson & Son Company. Mr. Basse has been in the employ of this company since November, 1900, and for the past ten years has held various positions in the sales department at Chicago. In August, 1918, he was transferred to the Detroit office as acting manager of the Detroit plant, succeeding Ralph J. Stayman, who left the company temporarily to fill a war vacancy existing at the Chicago office and who later resigned.

The Oliver Machinery Company, Grand Rapids, Mich., in order to take care of increased business, has found it necessary to enlarge its Chicago office and has moved into new quarters at 810 Railway Exchange building, Chicago. G. C. Conklin, who for many years was connected with the factory at Grand Rapids, is in charge of the Chicago office as district manager, and George C. Ramer, who had formerly been connected with the St. Louis office of the company, has been added to the sales engineering force in connection with the new Chicago office.

A merger has been effected of the Hess-Bright Manufacturing Company, the S K F Ball Bearing Company, the Atlas Ball Company and the Hubbard Machine Company, the new company being known as the S K F Industries, Inc., which will handle a comprehensive line of ball bearings, including the Hess-Bright deep groove type, S K F self-alining radial and thrust bearings and ball bearing pillow-blocks and shafting hangers. The principal office will be at 165 Broadway, New York, with branches at Boston, Philadelphia, Atlanta, Buffalo, Cleveland, Detroit, Cincinnati, Chicago and San Francisco.

F. V. Sargent, has been appointed district manager of sales of the Chicago Pneumatic Tool Company, Chicago, with headquarters at Boston, Mass., to succeed F. S. Eggleston, who has resigned. Mr. Sargent was born in Belmont, Mass., on December 15, 1881. He began his business career in 1905 with the Bethlehem Shipbuilding Company as drafting clerk, and later was in charge of the heat treatment department and physical laboratories. In 1914 he entered the sales department of that company, in which capacity he remained until he accepted the position as district sales manager of the Chicago Pneumatic Tool Company.

Colonel Robert Andrews, one of the pioneers in American railroad construction and a former president of the Safety Car Heating & Lighting Company, died at his home in East Orange, N. J., on April 7, in his 85th year. Colonel Andrews was born August 2, 1834, at Andrewsia, near Wilmington, Del. His early schooling was at the Episcopal Academy of Cheshire, Conn., where he graduated in 1849. He then entered Trinity College, Hartford, Conn., graduating in 1853, and in 1854 completed a course at the Polytechnic College, Philadelphia. He adopted civil engineering as a profession, beginning his career as assistant engineer, Union Canal & State Canals of Pennsylvania. His long career of railroad engineering began in 1857 as principal engineer of surveys and construction on the Sunbury & Erie. In 1859 he went to the South Pennsylvania Railroad as principal engineer of surveys until the outbreak of the Civil War, when he was made a major of the 2nd Regiment, Delaware Volunteers. He was advanced to the rank of colonel in 1863. At the close of the Civil War he was made principal engineer of the Saratoga & Hudson River Railroad from 1863 to 1865; division superintendent of the Toledo, Wabash & Western from 1865 to 1873; chief engineer of the same road from 1873 to 1875, and general superintendent and consulting engineer of the Wabash System from 1875 to 1884. Then for one year he was consulting engineer of the Wabash, St. Louis & Pacific, and in 1885 was made general superintendent and engineer of the Virginia Midland. In 1889 he left railroad service to take the position of vice-president of the Safety Car Heating & Lighting Company. In December, 1901, he was elected president of this company, and from May, 1907 to 1915, he was chairman of the board of directors.

Col. Robert Andrews

Captain C. A. Duntley, who recently received his honorable discharge from the army after serving as captain in the 27th Field Artillery, has been elected vice-president of the Duntley-Dayton Company, with headquarters in the Westminster building, Chicago. He was born in Chicago on October 21, 1892, and received his education in Armour Institute, Chicago, and at Cornell University, from which latter school he was graduated in 1914. Captain Duntley will have charge of the sales work of the pneumatic and electric tool department of the company.

A. L. Humphrey, whose election as president of the Westinghouse Air Brake Company, succeeding John F. Miller, was announced in these columns last month, has been connected with the Westinghouse Air Brake Company since 1903 when he was appointed western manager with headquarters at Chicago. He was born in Buffalo, N. Y., and his family moved to Iowa when he was less than a year old. At the age of 14 after the usual amount of country schooling he struck out for himself and engaged in various occupations. At the age of 22 he organized a general machine shop and foundry in Seattle which afterwards became the present Moran Iron Works. He then entered railroad service and became constructing division foreman of the Mojave division of the Central Pacific, then master mechanic and later superintendent of motive power of the Colorado Midland. At about this time he took an active part in politics and was twice elected to the Colorado House of Representatives and during his second term served as speaker of the House. He then went back to railroad service on the Colorado & Southern in 1899 and went to the Chicago & Alton in 1903 as superintendent of motive power, soon after which he was appointed western manager of the Westinghouse Air Brake Company at Chicago. He went to Pittsburgh in 1905 as general manager of the air brake works, and was elected a director of the company in 1909 when he was also given the dual position of vice-president and general manager, which he held ever since. When the Union Switch & Signal Company was taken over by the air brake company in 1916, Mr. Humphrey was also elected president of that corporation. In addition he has been active in an executive capacity in all the other interests associated with the Westinghouse Air Brake Company, such as the Locomotive Stoker Company, Pittsburgh; the National Brake and Electric Company, Milwaukee; the American Brake Company, St. Louis, and the Westinghouse Pacific Coast Brake Company, San Francisco. During the war the companies of which Mr. Humphrey is in charge accepted from the British and Russian governments, contracts for the manufacture of shrapnel and explosive shells as well as time fuses numbering approximately four to six million units and component parts of war material, involving the expenditure of about $20,000,000 which contracts had to

A. L. Humphrey

be completed in a specified time. Mr. Humphrey not only put up factory buildings, installed special machinery and created an entirely new and separate organization for the construction of this work, but he also finished the job on time without having a single piece rejected. When the United States entered the war Mr. Humphrey received for the Union Switch & Signal Company a contract to produce 4,100 aeroplane engines of the Le Rhone type. Besides his activity as a manufacturer, Mr. Humphrey also acted in a consulting and advisory capacity to the government in Washington on many committees and boards. He was industrial "staff expert" for Brigadier General C. C. Williams, chief of the Ordnance Department, he was a member of the committee on Labor of the Council of National Defense, as well as a member of the War Industries Board and the War Resources Committee in Washington. He is president of the Employers' Association of Pittsburgh and a director of the Chamber of Commerce. Besides the election of a president, the stockholders at the annual meeting elected the following board of directors: Ben V. Becker, James D. Callery, E. M. Herr, A. L. Humphrey, John F. Miller, John R. McCune, John R. McGinley, Charles McKnight, M. S. Rosenwald, W. D. Uptegraff and H. H. Westinghouse.

E. I. du Pont de Nemours & Co., Inc., announces the organization on April 1, 1919, of E. I. du Pont de Nemours Export Company, a subsidiary corporation, created for the purpose of handling foreign business. The officers of the new company are as follows: F. W. Pickard, president; W. S. Gavan, vice-president and director of sales; F. D. Brown, treasurer; Alexis I. du Pont, secretary. The same staff which has previously been associated with the du Pont export business will be continued with some additions made necessary by the broader scope of the new corporation. The main offices will be located at 120 Broadway, New York, with branches in San Francisco, Mexico City, London and Rio de Janeiro.

Lieutenant Commander H. J. Elson, U. S. Naval Reserve Force, has been released to inactive status and has resumed his civilian work as secretary and treasurer of the Walter A. Zelnicker Supply Company, St. Louis, with which company he was in charge of internal management and manufacturing operations. Lieutenant Commander Elson was graduated from the U. S. Naval Academy in 1898, and after service in Cuba, the Philippines and China, resigned from the navy in 1902 to become interested in the Zelnicker company. He was chief engineer of the Missouri Naval Militia, with which organization he was mobilized into federal service upon the declaration of war, April 6, 1917. His assignment was as inspector of machinery, 9th, 10th and 11th Naval Districts, with headquarters at Chicago.

The American Steam Conveyor Corporation, Chicago, announces the appointment of Charles H. Florandin, formerly of the National Electric Welding Company, New York, as general manager of the eastern territory, with headquarters at the New York office, 110 West 40th street. Mr. Florandin was born in France and received his technical education at the famous Lycee de Marseilles. He is an engineer by profession, and upon coming to the United States did important work with the Brooklyn City Railway in the early days when the road was being electrified. After five years' service with this company, he joined the C. & C. Electric Company, New York, where he held a responsible position with them for many years. After a brief connection with the Western Electric Company, he returned to the C. & C. Electric Company, and later organized the National Electric Welding Company. During the war Mr. Florandin was a member of the welding committee of the Emergency Fleet Corporation.

Catalogues

Pneumatic Hammers.—Bulletin 101 has been issued by the Duntley-Dayton Company, Chicago, this being the first of a series of publications which this company has in preparation. It is devoted to the Duntley-Dayton line of riveting and chipping hammers, of which there are 20 sizes and styles, and features their low cost of maintenance. Pneumatic holders-on, pneumatic rammers, rivet sets, chisel blanks, hose, hose couplings, grease and oil, and lead hammers for use in repairing pneumatic tools, are also presented.

Motor Drive.—A universal motor drive for any kind of double spindle shaper has recently been developed by the Oliver Machinery Company, Grand Rapids, Mich., and this company has now printed a bulletin fully describing and illustrating the device and showing its advantages. It also includes a drawing showing the floor plan of the motor drive operating in connection with the Oliver No. 483 high speed double spindle shaper. A description of this device was published in the February, 1919, issue of the *Railway Mechanical Engineer*, page 107.

Air Transport System.—The Quigley Furnace Specialties Company, New York, has developed a system of carrying pulverized fuel which differs from screw conveyor and high pressure blast systems in that the fuel is transported in bulk from the pulverizing plant through small diameter standard wrought iron or steel pipe by compressed air to bins at the furnace, without the use of return piping. This system and the various apparatus used for the transport, distribution and burning of the fuel is described and shown in a diagrammatic drawing in Bulletin No. 11, containing 14 pages.

The Unit Car.—A steam propelled car, designed for railroad interurban and branch line service, known as the Unit car, is described in an attractive booklet containing 16 pages, issued by the manufacturer, the Unit Railway Car Company of Boston, Mass. As the name of the car indicates, its power plant, passenger and baggage space is combined in one car and it has been operated successfully and demonstrated its adaptability for satisfactorily handling short line traffic. The text is illustrated with photographs of the car and drawings showing the side elevation, floor plan and front end.

Cranes for Shops, Roundhouses and Yards.—The Whiting Foundry Equipment Company, Harvey, Ill., has recently issued catalogue No. 135 superseding catalogue No. 127. This catalogue describes electric, pneumatic and hand power traveling cranes, locomotive and coach hoists, gantry traveling cranes, jib cranes and pillar cranes. It gives a general description not only of the cranes but also of the details such as cabs, trucks, brakes and electric equipment, and discusses the field where the various types may be used to advantage. The illustrations show numerous typical installations on railroads.

Ash Disposal.—The American Steam Conveyor Corporation, New York, has issued a 160-page book on modern methods used in handling ashes in power plants. The first 32 pages are devoted to an exposition of the various methods in common use for the handling of ashes, including manual labor and the various mechanical and "current" methods. The remainder of the book is devoted to an explanation of the steam-jet conveyor method and its application to various types of boilers and furnaces together with a large number of descriptions and illustrations of actual installations of this equipment for office buildings, factories, railroads, etc.

Railway Mechanical Engineer

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CONTENTS

EDITORIALS

Why This Number?

TWO Shop Equipment Numbers of the *Railway Mechanical Engineer* have preceded this one. The first of these was published June, 1917, and the second June, 1918. This number is much more extensive and elaborate than either of the two preceding ones. There are two very good reasons for this.

As we have pointed out in these columns during recent months, it is necessary to do one of three things if the railroads of this country are to be maintained upon a satisfactory and efficient basis: either rates must be raised, wages reduced, or the efficiency of operation increased. Raising rates is a most difficult proposition and the director general of railroads is, apparently, not disposed to take any steps in this direction. It is desirable that the wages be maintained on the present basis. The only other alternative, therefore, is to increase the efficiency of operation by the introduction of the most efficient and economical methods and practices, by the improvement of facilities, and by bringing up the individual output of each employee. The elimination of piece work in many shops means that they must be entirely reorganized in various respects, in order to maintain their productive capacity even on the old basis. One purpose of this special number, therefore, has been to present constructive suggestions as to increased and more efficient shop production which will be helpful to those who are responsible for the maintenance of locomotive and cars.

The second thought that the editors had in mind in building up this special number has been to bring to the attention of railway mechanical department men all of the recent developments in machine tools and shop equipment that may be helpful to them. This is commented on in detail in the editorial following. Incidentally the editors would like to know to what extent this number proves helpful to you.

New Tool Section

DURING the war the builders of machine tools and shop equipment had little or no opportunity to improve their lines for general purposes, although some really remarkable improvements and developments were made in connection with the work of manufacturing munitions and war supplies. Now that the conditions are becoming more normal, the manufacturers are improving their lines so as to better meet the new conditions in the industrial field. The scarcity of skilled labor and the increased wage scales have created a heavy demand for labor and time saving tools and facilities. Possibly this, more than any other one thing, is the keynote of the large section in this number which is devoted to descriptions of new and improved machine tools and shop equipment.

Possibly something should be said as to the meaning of the expression, "new and improved machine tools and shop equipment." A large part of the material in this section covers entirely new designs. There are, however, a number of articles which cover products that have been improved in some of their parts only; in a few cases, tools or equipment have been described because of the addition of a new size to a line which has already been well established and is well known. Then there are several articles covering tools or equipment which cannot be classed as strictly new or improved because they have been manufactured for some time in practically the same form as they are at present. We decided, however, to describe some of these because recent changes in conditions have made their application to the railroad shops of very considerable importance, and a determined effort promises to be made on the part of their makers to bring them to the attention of the railroads.

Those who are planning on attending the June mechanical conventions will be particularly interested in a number of new or improved tools that are described in this issue which will be on exhibition at Atlantic City.

Our Advertising Pages

IT is rather unusual for the editorial department to make special reference to the advertising pages. We cannot, however, let this opportunity pass without commenting upon the really remarkable display in this special Shop Equipment Number. Great changes have taken place in the advertising pages of the technical and business papers during the past decade. The manufacturers were formerly content with using advertising space largely for display cards in order to keep their names before the public. Gradually they came to a realization that it would be far better to use this space for educational purposes by setting forth in an attractive manner the functions and advantages of their products. The difficulty in many cases was that the manufacturers did not have the facilities for getting together the necessary material or of putting it into attractive shape.

One of the greatest editors which the railway mechanical department has ever produced, used to say that the time would come when the advertising pages would be read in preference to the editorial pages because the advertiser, unhampered by those standards as to form which must necessarily be observed by the editor, would be able to make the material more attractive to the eye. The editors are not worrying, but so rapidly have conditions improved in preparing advertising copy that there is no question but what our readers will be forced to study the advertising pages critically and carefully. Unlike conditions 10 years ago, the copy is changed with each issue, thus helping to maintain the interest.

A large part of the data in the advertising pages in this and in our regular issues includes photographs which were actually taken in railroad shops and upon time studies which were made at the same time. While we have made no actual comparisons, it is quite probable that it costs more to prepare the average page in the advertising section than it does to prepare a similar amount of material for the editorial pages—and the publisher will tell you emphatically that the editorial department of this publication is an expensive institution.

Problems of the Air Brake Organization

THE Air Brake Association met this year under conditions that were more nearly normal than existed at the time of the convention last year. Problems bearing on war conditions occupied the attention of this body at the 1918 meeting; the discussion this year showed that the biggest problem which the air brake department has to face now is the improvement of the standard of maintenance. Last year brake equipment was not adequately maintained, and while some of the deterioration has been offset in the past few months there is still an abnormally large amount of equipment which is not up to the required standard. With the maintenance forces working shorter hours there is an increased necessity for getting the most effective work from the entire organization. Under the stress of war conditions some of the practices of former years were allowed to lapse. The question to be considered now is, which methods should be resumed and which abandoned.

The experience through which the railroads have passed has demonstrated the need for some organization on each system to supervise the air brake service. Some roads have been inclined to lean rather heavily on the service organization of the air brake companies. The staff of experts employed by the manufacturers should be called on to act only in a consulting capacity and they cannot be expected to handle routine matters such as the training of employees. This is properly a function of the railroad organizations and where the roads do not employ their own forces to handle this work, the service is almost sure to suffer.

The labor situation in the air brake department has undergone a radical change and will probably never revert to the old conditions. In past years there were plenty of competent air brake mechanics, but now the supply is inadequate and the roads must train men to do this work. The intricacies of the modern equipment cannot be mastered in a few days or weeks and in order to build up the shop organization with experienced men, special inducements should be offered to the employees on the more important jobs. In some instances wage differentials recently established have had the opposite effect, and as a result the shop organizations have been disrupted. It seems probable that there will be a large labor turnover for some time to come, as the shifting of workmen will continue until more stable industrial conditions are established. Instructions in the simplest form will be needed to enable the new men in the air brake department to become proficient in their special work as quickly as possible. The general distribution of the M. C. B. instructions on the maintenance of air brakes has had a good effect. The more detailed report of the Air Brake Association's committee on freight car brake maintenance should prove a great help in the difficult work of training the new employees.

Machinery Repairs on Heavy Locomotives

THE changes in the construction of locomotives during recent years have eliminated some of the defects that were most troublesome in earlier designs. Locomotives of moderate size now give large mileage between shoppings, but designs in which the maximum weight on drivers and tractive efforts are sought as a rule have certain weak points which add to the expense of maintenance and the proportion of time out of service. The development of designs for large locomotives in which no part will have an unduly short life demands the attention of those who design and maintain motive power.

It is interesting to note the general changes in locomotive repair work during the past decade. The mileage between flue renewals has probably increased somewhat while there is but little change in other boiler repairs. Frame failures, which formerly were a constant cause of annoyance, have been almost eliminated. General machinery repairs amount to about the same proportion of the total as before, but the work on rods and driving boxes has caused more and more trouble as the size of the locomotives has increased. The increase in rod work is a natural result of the use of larger cylinders, causing greater stresses, without a corresponding incease in the length of bearings. Long rigid wheelbases add further to the difficulty of maintaining rod bushings. The increased wear on driving boxes is due to greater stresses combined with a wider spacing of cylinder centers and a narrower spacing of frames. This is perhaps a more serious matter than the short life of rod bushings due to the greater difficulty of performing the work on the boxes.

The added difficulty of maintaining these important machinery parts will undoubtedly increase the time locomotives are held out of service and may even prove a limiting factor in the design of large motive power units. Comparatively few attempts have been made to improve on the types of bearings used or the material from which they are made and investigations along these lines may lead to the development of more serviceable designs. Another opportunity for eliminating the trouble lies in designing the parts so that they are more easily removed. The most promising alternative, however, seems to be the adoption of an articulated construction for extremely large locomotives. By dividing the power between two units the individual stresses are reduced and in spite of the added complication, the design would probably give less trouble than a locomotive with a long rigid wheelbase and might even in the end prove cheaper to maintain.

Machine Tool Situation Abroad

AMERICAN business men visiting England and the Continent since the signing of the armistice have learned somewhat to their displeasure that while there is a great need for material and manufactured products of all kinds, there is but little actual business being done. This applies particularly to the machine tool industry. The London agents are extremely busy answering inquiries but have received very few orders. The industrials, particularly those which manufactured munitions during the war, are seeking products that can be made without too great a change in the equipment of their plants. With every new product considered there are requirements for machines they do not happen to have and prompt inquiries are made to ascertain the price and deliveries of those machines. Thus the agents are kept busy, all to no seemingly definite purpose. It is this—the readjusting period—that is so trying. And further, but little actual business is expected for possibly two, six or nine months after peace is signed.

The railways, on the other hand, are in immediate need of machine tools, because there was but little replacement of "railway shop machinery" during the war, and because much of this machinery was given hard usage during the war on munition work in addition to railway work. Careful investigators of the market have picked the railroad field as offering the best possibilities for early sales.

The extent to which the American machine tool manufacturer will participate in this field depends on several things. That he will participate to some extent there is but little question in view of the urgent demand, but the extent to which he will participate hinges upon credits, deliveries and price. In the first place it must be remembered that foreign countries needing machines most have been at war, or, if they be neutrals, have felt the effects of war for over four years, and their financial condition is weakened. They need money and credit. Our government can help in this respect. It is rumored that England has made a loan to Roumania for railroad rehabilitation with the proviso that the money be spent in England. With judicious use of the War Finance Corporation's bond issue of $200,000,000, American exporters can likewise be assisted. In the matter of deliveries American manufacturers have the advantage although the shipping problem still remains serious. The price, however, is going to be the principal difficulty. It is not so much the cost of the tool at the point of manufacture as at the point of delivery. With the excessive and unregulated freight rates now existing on vessels sailing out of American ports, the American manufacturer is at a marked disadvantage all over the world. Some commodities can be shipped from England to

South American ports cheaper than from the United States. American shipping must be made to co-operate more closely with the American exporting industry.

At best American manufacturers of machine tools will be at a disadvantage with European manufacturers of like tools in European markets on account of distance. There are many tools, however, which the Europeans have left to American manufacture for the principal reason that, regardless of the additional ocst due to freight charges, they have not thought it profitable to make them. However, if prices remain too high for very long, it is going to pay the European to enlarge his line of tools, and England particularly is anxious to do this. At the present time purchasers, because of the excessive prices, are buying only those American tools they absolutely must have. Where by any chance purchases can be delayed, they are, with the hope that lower prices will come later. Some even suggest that purchasers are waiting for a low German market! It really is a serious question as to how long sentiment will stand up against a depleted pocketbook. It is very necessary for American machine tool manufacturers, and other manufacturers as well, who really want foreign business to do their utmost in getting into the market, in facilitating credits and extensions and in bringing freight rates down so that they may compete on a more even basis.

The Labor Situation

THE abolition of piece work is a matter of controversy on which there are probably almost as many shades of opinion as there are individuals interested in the subject. But whatever opinion may be held, the fact remains that piece work is out of consideration for the present and it is obviously the duty of everyone having to do with railroad shop administration to accept the situation and make the best of it. In an article on another page will be found a discussion of the fundamentals of wage payment which, while abstract in its treatment of the subject, is worthy of the most careful consideration. The principles therein set forth are, we believe, correct and the first step in the solution of any problem is an understanding of its fundamental principles.

The greatest difficulty in the application of these principles to any system of wage payment lies in the human problem of arriving at a common understanding of what constitutes the "reasonable measure of skill and effort" which the management has a right to expect, and the "commensurate rate" which should be paid for its exercise. It is precisely this problem that underlies the greater part of all our difficulties in securing a satisfactory man-hour output and in maintaining industrial peace. Neither the piece work system, the various bonus systems of wage payment, nor profit sharing schemes have been the solution of this problem. None of them has removed the real difficulty; i. e., the lack of a common understanding by the workmen and the management of what service should be rendered on the one hand and what should be expected in return for that service on the other.

Whatever scheme has been adopted, the basis on which it is administered has been fixed, more or less justly, by one or the other of the interested parties, but never to the satisfaction of both. This is true whether it be a bonus schedule fixed by the management in a non-union shop, or an hourly wage scale dictated by the workmen in a closed union shop. In the former case, whatever the general opinion as to the justice of the basis may be, the opportunity to increase earnings by increased effort has tended to satisfy the more skilled workmen only, the primary cause of general discontent not being removed. In the latter case both parties may agree on the "commensurate rate," but the management is seldom satisfied with the "measure of skill and effort" which is exercised in return. The two cases are fundamentally the same; in neither have both parties to the agreement had a voice in framing the platform on which they must work together.

In either case the principle is despotic, whether or not it results in injustice. Self-respecting human beings can not be contented when subjected to despotic control, even though its exercise may not result in tyranny. It is an inherent characteristic of human nature to desire a hand in the settlement of its own destiny.

A number of experiments in what has come to be designated as industrial democracy are now being conducted, notably in the steel industry, the outcome of which it would be unwise to predict. They are all based on the same fundamental principle, namely, that the management on one hand and the workmen on the other have equal rights to a voice in the determination of the conditions under which they must work together. Whatever the results of the detail plans which have been put in practice may be, the principle on which they are founded is sound and the experiments may well be watched with the keenest of interest.

There is nothing radical in this principle. It is the basis of all contracts and is the only way in which whole-hearted support of an agreement can be secured from both parties interested. Terms virtually dictated by either party, no matter how just in themselves, are not conducive to the best relations between the parties during their administration. This principle does not interfere with the right of the management to exercise its functions. It is still the duty of the management to conduct the industry, the difference between the new plan and time-honored methods being only that it is conducted according to law established by agreement to safeguard the interests of both the management and the workmen, rather than in accordance with the unregulated inclination of either one or the other of the two parties, which may or may not be tyrannous in effect, but which is despotic in principle.

How Railroad Administration Circulars Affect Car Repairs

ONE of the clauses in the contract of the railroad companies with the Railroad Administration provides that the equipment shall be returned at the end of federal control in substantially as good condition as when the roads were taken over. At the present time traffic is light and cars are available for repairs, yet apparently little effort is being made to improve the condition of equipment. The percentage of bad order cars is being reduced, to be sure, but a single heavy repair car requires as much work as several light repair cars and the increase in the number of heavy bad orders more than offsets the decrease in the number of lights, the net result being that there is a deterioration rather than an improvement in the average condition of equipment.

At the present time many of the heavy bad order cars are being set on sidings instead of being sent to the repair tracks. An accumulation of heavy bad order cars presents a serious problem for the shop forces and caring for light repairs to the exclusion of the heavies can only be justified as an expedient for making available the greatest possible number of cars when there is a shortage of equipment. No such condition exists at this time, nor can the policy be justified on other grounds. The Railroad Administration probably did not intend to restrict the repairing of heavy bad order cars; the present situation is rather an incidental result of the attempt to standardize repairs to freight equipment.

The most drastic regulations concerning car repairs are found in circular No. 7, which prescribes standards for repairs to refrigerator cars. The standards in themselves are excellent, but they specify types of construction radically different from those used in the majority of railroad owned refrigerator cars. To require cars to be changed to conform with the new standards would necessitate heavy expenditures.

The situation is further complicated by the provisions of circular No. 20, limiting the amount to be spent for repairs or additions and betterments to equipment. If both these circulars were rigidly enforced some roads would be obliged to retire every refrigerator car they own and the minimum thus affected would probably be 10 to 20 per cent.

A similar situation exists with regard to circular No. 8, which will require a large amount of work or the destruction of a great many cars. It has been estimated that circular No. 8 applied in connection with circular No. 20 would force the retirement of as high as 20 per cent of the cars on many roads. The rules governing minor repairs are also unreasonable in some cases. For instance, to apply a standard body bolster would often necessitate a change in the truck bolster, which in turn would call for new truck sides. It would seem advisable to permit existing standards to be maintained on the older cars to avoid the unreasonable heavy expense entailed under such circumstances.

It is not only in conjunction with the standards for repairs that objections are raised to circular No. 20. The provisions of this circular alone will require heavy expense for remodeling or will force the retirement of many cars. It does not fit in well with the reinforcing programs of the majority of the roads. For instance, some lines have equipped cars of 50,000 lb. capacity with steel center sills, thus making them fit for service in heavy trains and providing a type of equipment that fulfills the requirements in many classes of service, yet the limit of repairs on these cars is set at $75. The circular undoubtedly errs in not taking into account the condition of the individual car. The limit to the amount that can be expended for repairs drops sharply when the car reaches the age of 20 years, though there is no corresponding decrease in the actual value of the car. The circular might be justified if freight cars had a definite and uniform life. As a matter of fact, extended investigation has shown that in actual service the physical condition of cars does not deteriorate beyond a certain point. The condition of individual cars varies considerably, so the amount of expense that would be justified in repairing them would be subject to a corresponding variation.

Because of the operation of circulars 7, 8 and 20 the roads are setting aside many cars, or are making temporary repairs. Such practices will cause the equipment to deteriorate rapidly. Freight cars are now being returned to the owning roads, and as the standards of the individual systems can be followed, the necessity for uniform repair standards no longer exists. Under these circumstances circulars 7, 8 and 20 should be revised in order to facilitate the much needed improvement in the condition of freight cars.

The Mechanical Conventions

THE mechanical conventions will be held at Atlantic City this year, from June 18 to 25. The meetings last year were little more than a gathering together of representatives of the various committees so that the convention this year is really the first one since June, 1916. The three years since that time have been crowded with unusual experiences for the men in the mechanical department of our railroads; never has the necessity for maintaining the equipment in good condition at all times been so forcefully drawn to the attention of the chief executives and those in charge of the operation of the roads. Too often in the past the mechanical department has been tolerated as a necessary nuisance. This has rather tended to discourage the mechanical department officers and has hampered the development of the department.

The time is now ripe for the mechanical department to assert itself and to insist upon having adequate facilities and authority to keep the locomotives and rolling stock in such condition that they can be operated to the best advantage. The mechanical department must insist that locomotives be not allowed to run when in poor condition and that the cars be kept on the repair tracks if not in condition to be used. Will the mechanical department officers take advantage of the changed conditions or will they let the opportunity go by and allow the effect of the lesson to be lost? It will be interesting to watch the conventions from that viewpoint.

Of course, it is necessary to develop standards and recommended practices and to spend a lot of time in technical investigations and analyses. It is true that the mechanical department officers are confronted with the most intricate engineering problems and must give much attention to them; on the other hand, they must not forget that they are executives and that the large questions as to organization, personnel, production and things of that sort are far more important in the interests of efficient and economical operation than is the technical detail work of the department. It is strange, in studying the proceedings of the Master Car Builders' and Master Mechanics' Associations, to see how little real attention has been given to these larger problems.

Take the labor problem. There has been too much beating around the bush and too little straightforward talking in the open on this question. It is safe to say that there are a great many mechanical department men who, because of this, are at least a generation behind the times in the understanding of the labor situation and the best ways in which to secure real co-operation between the men and the management. What better place could there be to discuss this problem in a big way than at the Atlantic City conventions?

Piece work has been done away with and there is apparently a tendency to discourage discussing it in public. There is, however, no more important question demanding the solution by the mechanical department than as to the best ways in which to reorganize the departments which were working on a piece work basis in order to keep up their production capacity. The problem can be solved and if the men now in charge do not tackle it in earnest, it will be necessary to supplant them with other men of keener vision. There are many men who, because of experience, environment or nature, have failed to realize the significance of the change that has taken place in conditions in recent years. One big thing that can be done at Atlantic City is for the leaders to develop this situation clearly and to encourage their brothers to tackle the job with renewed energy and inspiration.

Frank McManamy, assistant director of the Division of Operation, has made a splendid move in suggesting that the superintendents of motive power instruct their representatives at the convention to make notes of those things that particularly appeal to them and report back in writing as to the practical things that were brought to their attention at the meetings, either at the formal or informal gatherings or in visiting the exhibits. Mr. McManamy's purpose must not be misunderstood. He is exceedingly desirous that the Railroad Administration should receive credit for helping to make the present conventions the best and most productive that have ever been held. The Administration will make a heavy investment in sending the men to the conventions and it is desirous of getting the biggest possible returns for this expenditure. This is good business and is to be commended. The fact that written reports are to be turned in does not mean, however, that Mr. McManamy or his assistants are going to check up the individuals and criticize their observations.

E. H. Walker, the president of the Railway Supply Manufacturers' Association, has been quick to take advantage of a real opportunity for co-operation with the Railroad Administration; arrangements have been made whereby each railroad man in attendance at the conventions will be furnished with a special and very conveniently arranged notebook, which promises to prove most helpful in noting down facts for future reference or for making the above mentioned reports.

The Northwest Corner of the B. & O. Shops at Glenwood, Showing the Heavy Castings Platform at the Right

The New B. & O. Shops At Glenwood

Longitudinal Type, 21 Pits; Crane Service in Erecting, Machine; Boiler, Blacksmith and Tank Shops

A NEW locomotive repair shop which, with the new equipment installed, represents an expenditure of more than $1,700,000, has recently been completed by the Westinghouse, Church, Kerr & Co., for the Baltimore & Ohio at Glenwood (Pittsburgh), Pa. The nature of the new shop layout was largely controlled by the rigid limitations of space imposed by the old shop site, most of which is included in the new shop, as no site for a general relocation was available.

The old shop was housed in a group of buildings starting with an old roundhouse which was used as an erecting shop, adjoining one end of which was the machine shop. The blacksmith shop, boiler shop and tank shop occupied three steel frame buildings with corrugated siding adjoining the end of the machine shop in the order named. Between the boiler shop and tank shop was located a transfer table. These latter three buildings were practically all included within the site of the new shop and continued to house their respective shops until the new structure was erected, after which they were torn down and the equipment rearranged in its proper location in the new building. The old machine shop and roundhouse structures remain and will be used to take care of some of the tank work, hose mounting for the car department, etc.

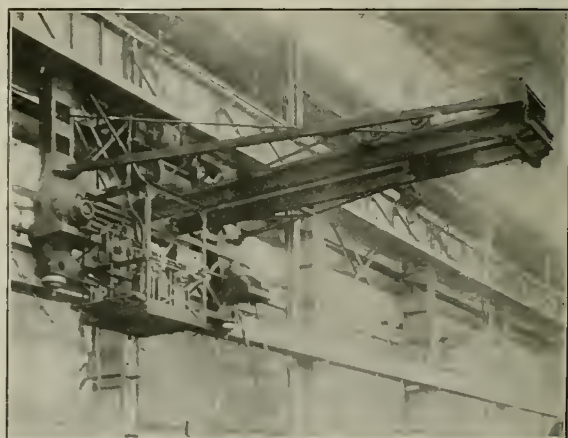
The new shop is of the longitudinal type, of steel frame, brick curtain wall construction and has a total length of 635 ft., with a width of 232 ft. 6 in. It is divided longitudinally into four bays. The monitor bay, 440 ft. of the north end of which is occupied by the erecting shop, is 90 ft. wide. On the east side of this is a single bay 42 ft. wide in which is located the tank shop, pipe shop, tin shop, cab shop and part of the blacksmith shop. West of the monitor bay are two bays, both of which are principally occupied by the machine shop. That adjoining the monitor bay is 62 ft. wide while the outside bay is 40 ft. 6 in. wide. With the exception of 120 ft. at the south end of the building, which is occupied by the storehouse, the outside bay contains a gallery floor, on which space is provided for a manufacturing tool room, facilities for electric repairs, a millwright shop, and the air pump, stoker and injector repair shop, the apprentice school room, offices for the assistant shop superintendent, the general foreman and the supervisor of shop schedules, and toilet facilities.

An unusual feature of the shop structure is the storehouse within the main shop building, which occupies 120 ft. of the west bay at the south end of the building. It is designed for six stories, five of which have been built, and is of reinforced concrete construction.

Along the entire length of the west side of the shop building is a platform 50 ft. wide, served by a 15-ton half gantry crane for about four-fifths of its length. Across the south end of the building is a space of the same width spanned by a 15-ton bridge crane, the surface of which is at ground level.

Equipment and Facilities

Operating over the entire length of the monitor bay there are one 100-ton Toledo bridge crane, one 100-ton Morgan bridge crane and four three-ton Toledo traveling jib cranes operating under the bridge cranes, two on either side of the bay. The east bay is equipped with a 30-ton Toledo bridge crane and in the inside west bay there is a 15-ton Toledo bridge crane. In the two west bays there are a number of one and two-ton electrically operated Yale hoists mounted on swinging jibs, about 15 of which eventually will be employed when the shop is fully equipped. There are two



One of the Three-Ton Traveling Jib Cranes, Serving the Erecting, Boiler and Blacksmith Shop

Otis freight elevators used for carrying material between the machine shop floor and the balcony, one of which also serves the storehouse, and an Otis automatic passenger elevator serves the four floors of the storehouse and the main office on the fifth floor.

In addition to the equipment moved from the old shops, the new plant contains 44 new machine tools, practically an entire new spring plant, a new 6,000-lb. steam hammer, two new forging machines, an additional power hammer and several furnaces in the blacksmith shop, and a new flue cleaner. Practically all of the new machine tools have individual motor drive and the greater part of the machines moved from the old shop are arranged for group drive. Many of the larger machines from the old shop were already individually motor driven.

There are two electric welding sets in the shop, one of which is illustrated. Both of the sets are Westinghouse constant voltage type welding machines; one has sufficient capacity for eight operators, while the other has capacity for five. Along each side of the monitor bay there are 12 welding outlet boxes, making a total of 24 welding outlets. Near the ends of the bay on each side there are transfer panels from which either welding machine may be connected to any welding outlet. Oxy-acetylene tank outfits mounted on trucks are used for cutting.

Good general lighting is provided for the entire shop and individual lights for separate machines have been dispensed with insofar as possible. The monitor bay is provided with four rows of 700-watt incandescent lights placed 22 ft. apart. The lights in the two center rows are fitted with deep bowl reflectors, while those in the outside rows are fitted with angle reflectors. All of the lights are placed above the cranes.

The north end of the east bay is provided with three rows of 400-watt incandescent lamps placed on 36-ft. centers. The two outside rows have angle reflectors and the center row has deep bowl reflectors. In the south end of the east bay the center row of lights is eliminated.

The inside west bay is lighted in the same manner as the north end of the east bay, except that the lights are placed on 22-ft. centers. Under the gallery there are four rows of 200-watt incandescent lamps in deep bowl reflectors 15 ft. apart, with the same lighting in the gallery.

New Tools Installed at Glenwood

2 30-in. vertical turret lathes.	1 26-in. by 12-ft. eng. lathe.
1 84-in. boring mill.	1 30-in. by 12-ft. eng. lathe.
1 44-in. boring mill.	2 27-in. by 14-ft. axle lathes.
1 D. H. rod boring machine.	1 D. H. center drive axle lathe.
1 slab miller.	1 3-ft. radial drill.
1 42-in. vertical miller.	1 4-ft. radial drill.
1 Keyseat miller.	4 5-ft. radial drills.
1 20-in. slotter.	3 20-in. drill presses.
1 24-in. slotter.	1 36-in. drill press.
2 28-in. crank shapers.	1 12-in. by 36-in. plain grinder.
2 24-in. crank planers.	6 emery wheels.
1 16-in. by 8-ft. eng. lathe.	1 100-ton hydraulic press.
2 18-in. by 10-ft. eng. lathes.	1 6,000-lb. steam hammer.
2 18-in. by 10-ft. portable lathes.	1 300-lb. power hammer.
1 20-in. by 10-ft. eng. lathe.	1 1½-in. forging machine.
1 24-in. by 10-ft. eng. lathe.	1 3-in. forging machine.
1 26-in. by 10-ft. eng. lathe.	1 6-in. pipe cut. and th'd machine.

The Erecting Shop, Looking Toward the South End of the Monitor Bay

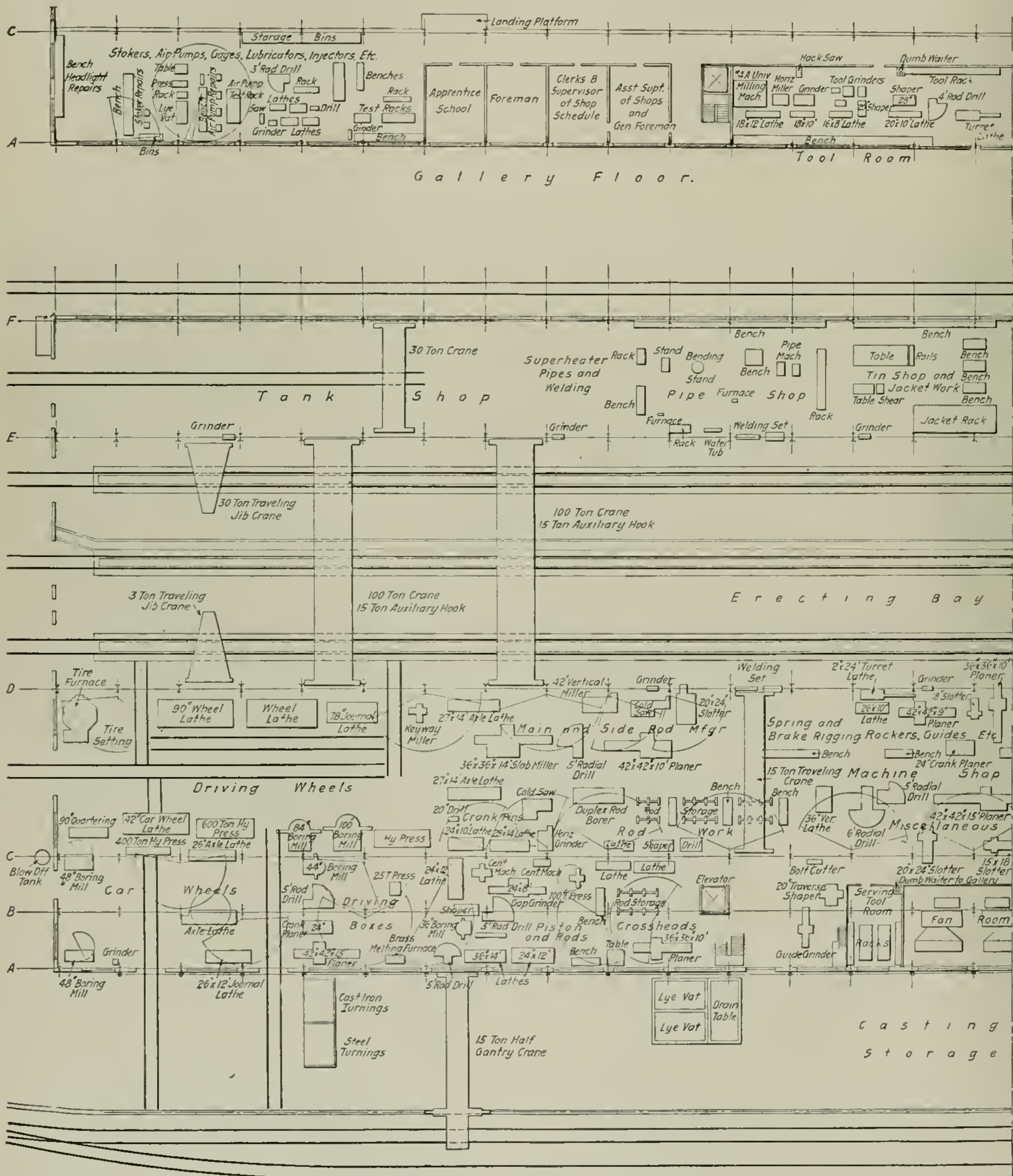
The existing power plant has insufficient capacity for the operation of the new shop and during the day power is brought from the Duquesne Power & Light Company. The night load is handled by the railroad power plant. This plant has been equipped with extra transformer capacity and rotary converters and during the day it is operated as a sub-station to transform the power to the various kinds needed in the shop. The lighting circuits use 110-volt single-phase alternating current, 440-volt three-phase alternating current is required for machine tool and elevator motors and 230-volt direct current power is used for crane motors and some of the machine tool motors.

All of the circuits are carried from the power plant to the shop by lead covered cables in fibre ducts under ground. The lighting feeders are brought up through the floor to the various lighting distributing panels, from which the lighting circuits are controlled. Each switch controls either three 700-watt, four 400-watt or six 200-watt lighting units.

The main power circuits rise from the floor through circuit breakers and cut-outs, just above the floor, to the power feeders, which are run open just under the roof of the east bay and the inside west bay for the entire length of the shop. Branches to individual motors or group motors are carried down the pillars from the feeders. Just before reaching the floor these branches enter a totally enclosed circuit breaker and cut-out, from which they go through a branch cut-out and thence under the floor to the motors. Each branch from the feeders is divided to supply from one to three motors. All wiring in the shop with the exception of the feeders is rubber covered and is all in rigid metal conduit.

Along with the rest of the electrical equipment, the shop is fitted with an electric time clock system. There are 16 branch clocks located at various points in the shop and one master clock located on the south wall of the balcony.

The building is heated by hot air, the system consisting of two 200-in., direct engine driven fans. The plant is a so-

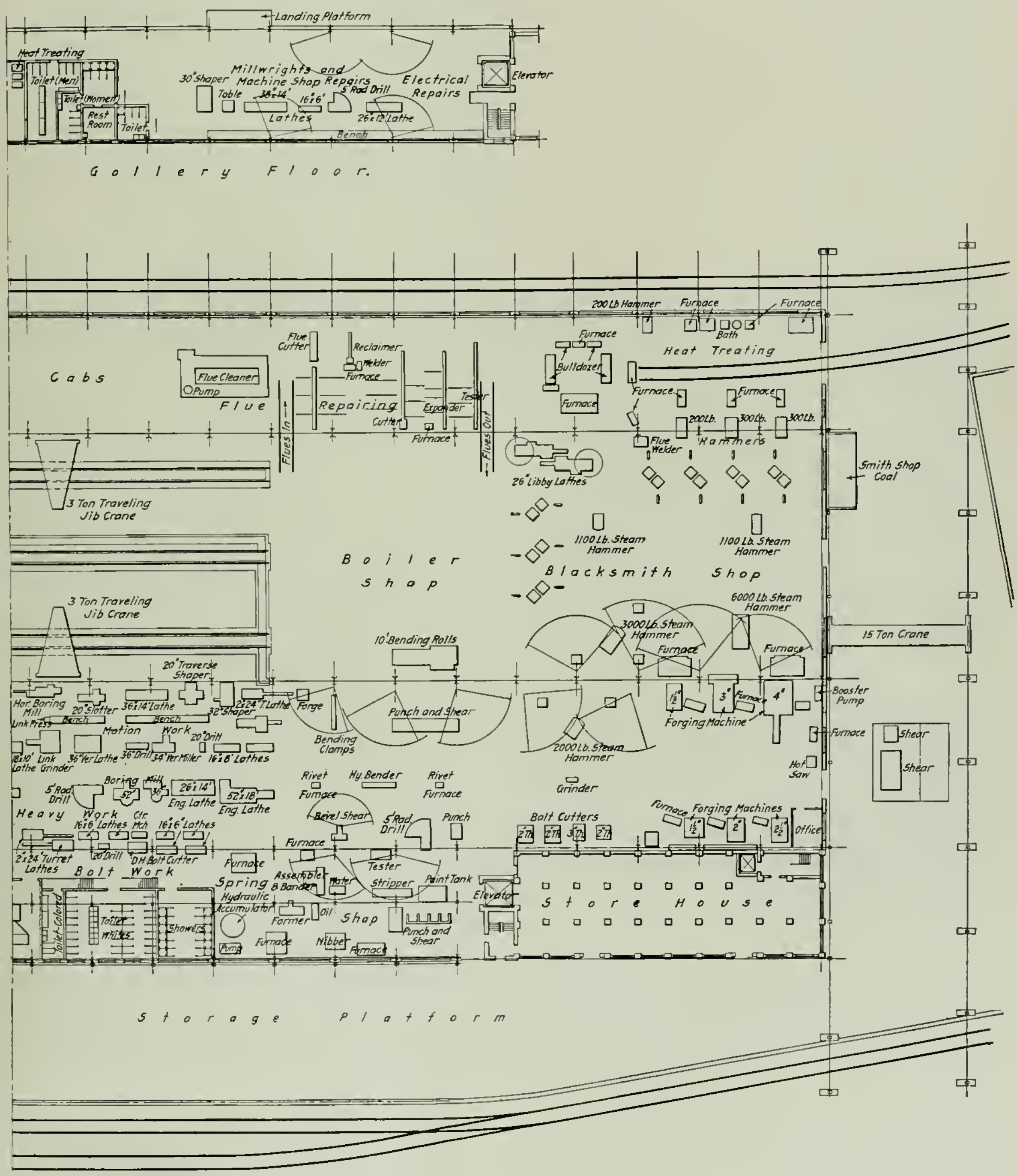


Plan of the North End of the Glenwood Shops called twin system with one fan for each end of the building. Before passing through the fan the air is heated by 71-in. Ventostacks, placed two tiers high and six stacks wide. The fans discharge into concrete heating ducts, forcing the air to outlet boxes at the columns and along the sides of the building. Each fan supplies heat for half of the building.

ERECTING SHOP

The erecting shop in the monitor bay, is 440 ft. long by 90 ft. wide from center to center of columns. It is provided with three longitudinal tracks, all of which are served by the two 100-ton cranes, while the outside tracks in addition have the service of two three-ton traveling jib cranes each. These cranes have a working range extending across the outside tracks to a line about eight feet inside of the inner rail in each case. The three tracks provide room for 21 working pits.

Space equivalent to about two pits on the east track is reserved for stripping as engines enter the shop. About the same amount of space on the middle track is reserved for



Plan of the South End of the Glenwood Shops wheeling and coupling up tenders on completed locomotives. At the present time approximately two working pits at the north end of the west track are used for wheel storage, but eventually one of these pits will be released by providing wheel storage outside the shop, only enough space being reserved on this track to take care of one set of wheels at a time.

As far as possible light repairs are taken care of on the east track, while the heavy repairs occupy the middle and west tracks.

As an engine enters the shop it is stripped and unwheeled on the north end of the east track, then being moved by the 100-ton cranes, one at each end, to a vacant pit on one of the three tracks. The locomotives as they are completed ready for wheeling are moved by the cranes to the north end of the middle track to be wheeled and when this operation is completed are replaced on their respective pits, where the erecting is finished, the valves set and the locomotive completed ready to leave the shop. It is then moved back to the north end of the middle track where the tank is coupled on and the engine then removed from the shop.

The three-ton jib cranes are used for handling light material and stripping and erecting the light parts of locomotives on the two outside tracks, thus greatly facilitating operations on these tracks and relieving the large cranes of a considerable amount of light work.

Another feature which facilitates the erecting shop work is the provision of two portable direct motor driven, 18-in. lathes, one in each erecting shop aisle. These are used on frame bolt work and may be moved to any engine in the shop where a heavy run of frame bolts is required.

All scrap material and refuse originating in the erecting shop is collected in open side steel boxes placed on the floor near the north end of the building. During the night scrap and dirt cars are moved into the building on the stripping track and the boxes dumped into them by one of the cranes, the cars being removed before morning.

MACHINE SHOP

The machine shop occupies both west bays, from the north end of the shop 440 ft. to the spring shop in the inside bay, and 260 ft. to the serving tool room in the outside bay. The heavier work is handled in the inside bay, which is served by a 15-ton traveling crane.

The wheel work is grouped in the north end of the building, driving wheels under the crane and car wheels under the gallery. The driving wheel and journal lathes are located so that the greater part of the work moves continuously in one direction. From the storage on the west track in the erecting shop the wheels are either moved by the crane to a cross track just north of the wheel lathe, or moved outside the building and brought in the machine shop on a track which is located in front of the machines and extends inside the shop to the cross track on which the finished wheels are moved over to the erecting shop. The equipment now includes one 90-in. wheel lathe and a 78-in. journal lathe. Eventually, however, another wheel lathe will be installed and a tire furnace will be placed just inside the north wall of the shop. New driving axles are handled just south of the wheel group, the equipment including an axle lathe and a keyway miller. New tires and wheel centers are bored and turned on two boring mills placed on the outside of the heavy machine bay just south of the driving wheel press.

The car wheel group in the northwest corner of the shop has access to the platform on the west side of the building by two tracks which enter the side of the building and extend entirely across the platform. The gantry crane is available for handling the wheels to and from the cars.

Looking North in the Heavy Machine Tool Bay Showing the Day Lighting and the Location of the Electric Lights

Axle and wheel storage occupy the platform adjoining these two tracks.

All driving box work is handled by one group of machines and facilities so arranged that the movement of the boxes from the time the first machine operation is started until they are refitted with the cellars complete, ready for the journals, is continuous with no back handling.

Driving Wheel Section of the Machine Shop Showing the Route of Wheels from and to the Erecting Shop

It is the practice of the Baltimore & Ohio to use brass hub plates and shoe and wedge faces, both of which are cast on the box. As the boxes come from the engines the hub plates are first stripped off on a vertical turret lathe, which also bores main rod brasses and rod bushings. The brasses are pressed out and then holes are drilled in the hub face of the box to hold the new liner on. These holes are drilled at different angles from the vertical in order to clinch the brass and this work is done on a radial drill, the box resting on a special jig which may be tilted from side to side to change the angles of the holes. New brasses are turned on a 36-in. boring mill and the corners fitted on a 28-in. shaper ready to press in the boxes. This shaper is also used to finish new axle keys, crank arm keys and eccentric keys.

The boxes and brasses are then moved to the press, from which they go to the brass furnace, which is placed under a hood opening through the side of the building, where the shoe and wedge faces and hub plate liners are cast on. The shoe and wedge faces are then surfaced on one of the two planers included in the driving box group. A 24-in. crank planer takes care of cellar work and some of the driving box work, while the other planer, which has a 15-ft. table, is also used on new shoes and wedges.

The boxes then go to a radial drill, where the holes for the crown bearing plugs are drilled, and the crown bearings are then bored on a 44-in. boring mill. The boxes are fitted up on the floor just in front of this machine, ready to be moved to the erecting shop.

This group of machines occupies a space less than 50 ft. square and the whole series of operations, including the fitting up on the floor, employs about ten men for from two to three sets of boxes a day.

The piston and crosshead work are grouped together in the outside bay just south of the driving box work and the tools and facilities are arranged so that all fitting of the two parts is handled with as little movement as possible.

Crank pins and rods occupy the space in the inside bay adjoining the piston and crosshead groups. New main and side rod work is handled by a group of machines on the side adjoining the erecting shop. These include a slab miller, a vertical miller, a five-foot radial drill, a slotter and a planer. The largest part of the machining on new rods is taken care of on the slab and vertical millers. The slab miller channels and finishes the sides throughout, and finishes the edges of the rod bodies, and the vertical miller is used to finish the edges of the stubs. The slotter is used partly on rod work, for main rod straps, and also finishes

Part of the Wheel Shop Group

the crown brass fit on new driving boxes. Not included in this group of machines, but located just across the longitudinal runway down the center of the bay, is a duplex boring machine. This machine is principally used on side rod work.

The spring and brake rigging work, rockers, guides, etc., and motion work groups adjoin the erecting shop south of the rod group, in the order named. Beyond these groups are the tools for handling miscellaneous heavy work and a number of machines, including two turret lathes, for handling bolt work. A portion of the outside bay opposite these groups is occupied by the serving tool room, which com-

The Heavy Forging Machines in the Blacksmith Shop; Looking Toward the Monitor Bay

municates with the manufacturing tool room in the gallery by means of a dumbwaiter. Adjoining the tool room are the fan rooms for the heating system and the toilet and wash room facilities, which include a group of 12 shower baths.

THE BOILER SHOP

The boiler shop adjoins the end of the erecting shop in the monitor bay and also occupies the space in the inside west bay adjoining the end of the machine shop. It extends from the south end of the erecting shop to the blacksmith shop, a distance of 88 ft. longitudinally of the building.

With the exception of the bending rolls, the tools are all located west of the monitor bay, leaving a practically clear floor space in the latter.

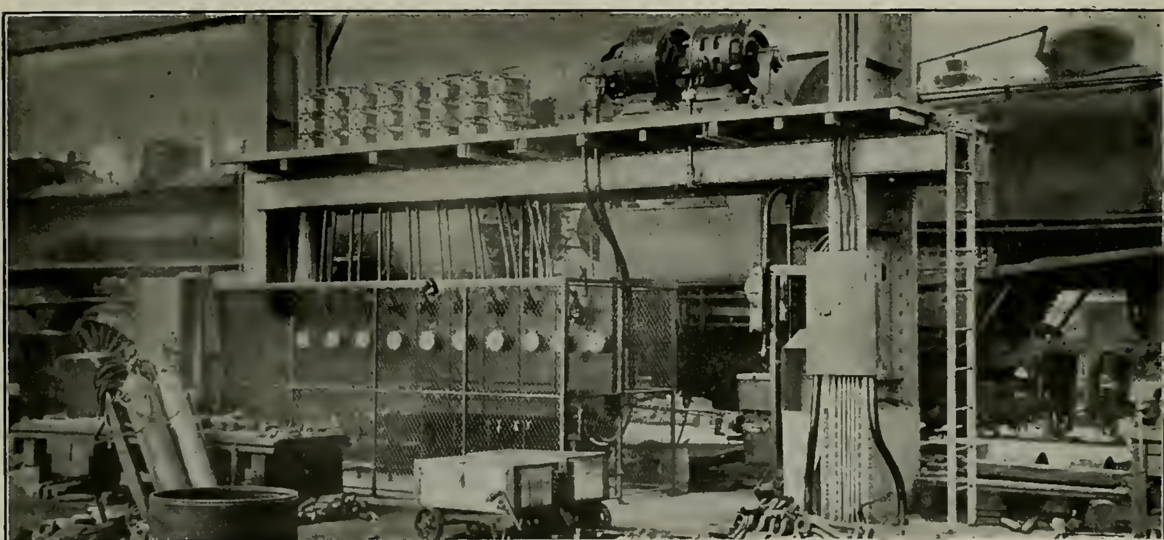
THE BLACKSMITH SHOP

The blacksmith shop is one of the most interesting departments in the plant. In addition to the usual run of light and heavy forgings, bolts, etc., this department includes a highly developed spring shop and also has jurisdiction over flue repairs. This shop handles all locomotive and car forgings for the Glenwood shops, as well as a number of forgings for other points on the system, and repairs four or five sets of flues per month for outside points in addition to those required for the engines in the local shop. It occupies the entire south end of the building with the exception of the corner occupied by the storehouse. Adjoining the boiler shop it is 110 ft. wide and it has additional space in the two side bays, the flue shop occupying 130 ft. of the east bay and the spring shop about 80 ft. under the gallery.

The equipment of the blacksmith shop consists of five steam hammers, three power hammers, four bolt threading machines, six forging machines and two bulldozers, and also includes a 26-in. turret lathe, with provision for the installation of another similar machine. This machine is used on crosshead pins, crank pin collars, knuckle pins, driver brake hanger posts, etc. These parts are rough turned for stock and are used for distribution to outside points, as well as at the Glenwood shops. The bulldozers, which are located on the east side of the shop, form a miscellaneous list of car forgings, which may be loaded directly into cars for removal from the shop on a track extending into the south end of the east bay.

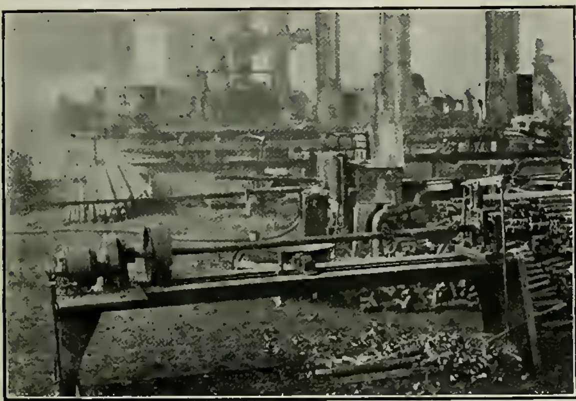
With the exception of the 2,000-lb. steam hammer, which is located in the adjoining west bay, the hammers are all placed in the monitor bay with ample floor space for handling large and heavy material. This part of the shop has the service of the 100-ton cranes and the traveling jib cranes. The lighter hammers are placed adjoining the fires while the 3,000-lb. and 6,000-lb. steam hammers are served by furnaces.

The flue shop is laid out with a view to continuous movement of the tubes from the time they leave the rattler until they are ready for reapplication. They are taken into the flue shop at the end of the erecting shop, where they



One of the Two Electric Welding Sets, Serving Outlets Conveniently Located at Various Points in the Building are placed in a pit type water cleaner. Adjoining the cleaner in the order named are located the flue cutter, the safe end furnace and welding machine, the cutter for trimming the tube sheet ends and the expander. From the expander the tubes go to the hydraulic tester, thence being removed from the shop. They are handled in and out of the flue shop by means of slings and the erecting shop cranes.

Superheater flues are handled separately. The furnace and welder which are provided for this work are located next to the power hammer group and are so arranged that there is room to handle the tubes between the bulldozer furnace and the turret lathe, longitudinally of the shop.



Looking South in the East Bay at the Flue Shop

The welder is used both for welding safe ends and cutting off the ends of the tubes. It is of the roller type and is converted from a welding machine to a flue cutter by removing the welding rolls and then replacing them with shear disks.

The spring shop equipment is practically all new and when fully installed will provide excellent facilities for this class of work. The equipment includes a hydraulic stripping machine, a hydraulic spring testing machine, a triple pressure assembling and banding machine, a forming table and a nibbing machine. A punch and shear adjoining a rack for storing spring stock, a paint tank for dipping the completed springs and a steam dryer complete the working equipment. The stripping machine, testing machine and banding machine are hydraulically operated and are served by a hydraulic pump and 10-in. by 10-ft. accumulator. The furnaces for the fitting machine and for drawing the temper on the plates each will be equipped with a pyrometer temperature recording set.

As springs are received from the erecting shop, they go to the tester. If the test indicates that the spring is in good condition it is returned to service. Should a broken plate show up, the spring is passed to the stripper where the band is removed and the broken plate and band replaced at the assembling and banding machine.

Where the spring needs renewing, it goes from the stripper to the punch and shear, where stock for new plates is cut. This goes to the nibbing furnace and nibbing machine. From the nibbing machine the plates go to the furnace adjoining the forming table to be heated for forming. Adjoining the forming machine is an oil bath in which the plates are cooled and hardened after being formed. They are then taken to the temper drawing furnace and thence pass to the assembling and banding machine. When completed each spring is tested and then painted.

The completed springs are placed in store stock, the engine from which they are removed is credited with scrap and new springs charged out to replace those removed. When only testing is required the work is charged directly to the engine and the springs replaced in service.

CAB, JACKET AND PIPE WORK

Just north of the flue shop, about 60 ft. of the east bay is provided for making cab repairs. The tin shop, which is largely devoted to jacket work occupies 50 ft. north of the cab work and the next 70 ft. is occupied by the pipe shop facilities. Floor space for taking care of superheater pipes and welding occupies 30 ft. north of the pipe shop.

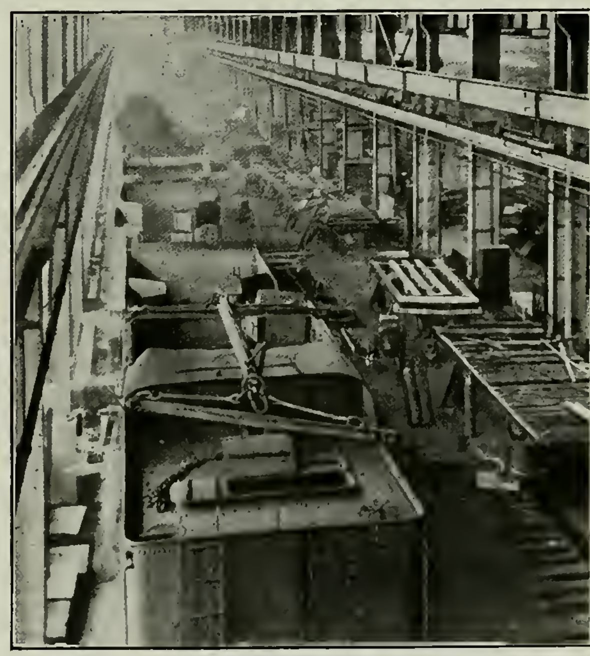
TANK SHOP

The tank shop is located at the north end of the east bay, of which it occupies about 175 ft. This shop is served by one track which enters the north end of the building and extends down the center of the bay about 130 ft. It is served by the 30-ton traveling crane which handles the tanks to and from the frames and removes the trucks from the track, placing them on the floor alongside the track.

The location of this shop at the north end of the building, where locomotives enter and leave the shop, reduces the amount of movement in placing and removing tenders in this shop. It places the shop entirely out of direct communication with the boiler shop. For the handling of such new material as is required, however, the two shops are connected by crane service.

THE GALLERY

On the gallery floor adjoining the storehouse is located the millwright and electrical repair shop, which occupies



A View of the Tender Shop

about 100 ft. Adjoining this shop are toilet facilities for men and women and a woman's rest room, the manufacturing tool room and offices for the assistant superintendent of shops and general foreman, the supervisor of shop schedules and other shop foremen. Room is also provided for the apprentice school. The air pump, lubricator, injector, stoker and gage repairs occupy about 130 ft. at the north end of the balcony.

Two landing platforms project out from the balcony over the heavy machine shop bay, where they are served by the 15-ton crane. One is opposite the millwright and electrical repair shop and the other near the specialty repair shop. Two elevators are also provided, one at the north end of the storehouse which it also serves, and the other at the north end of the manufacturing tool room.

STOREHOUSE

The storehouse, which occupies the southwest corner of the building is 120 ft. long and about 40 ft. wide. The fifth or top floor is occupied by the offices of the superintendent of shops and the local storekeeper. The four lower floors are devoted to storehouse stock. The fourth floor is given over to bulk storage while the third floor, which opens directly onto the gallery, contains the stock of material for air pumps, injectors, etc., which is disbursed directly on this floor. The second floor contains transportation department material while the ground floor is given over to mechanical department stock.

A storage platform extends along the entire west side of the shop building and is served by a half gantry crane of 15 tons capacity, for all but about 140 ft. of its length. Track clearance at the end of the building made it impossible to extend the crane service to the end of the building. This platform is used largely for storing castings and driving wheel tires, the bridge of the crane being arranged to extend over the adjoining track to permit of handling material to and from cars.

This platform contains two lye vats and a drain table. The parts to be cleaned are handled to and from the shop on trucks, it being the plan eventually to provide electric trucks for this service and for handling material into and about the shop.

Under the craneway at the south end of the building arrangements will be made for the storage of bar iron and steel stock.

NEW SHOP ORGANIZED WITHOUT LOSS OF OUTPUT

During the construction of the new shop the organization at Glenwood has been severely handicapped. Conditions demanded that locomotive repairs continue and an output consistent with the old shop facilities was aimed at during the transition period in which machine tools were being moved from their locations in the old shop to the positions which they now occupy in the new shop. This has substantially been accomplished, the work gradually being concentrated in the new shop as the completion of facilities and the placing of machines would permit.

The construction of the new shop at Glenwood is part of a general plan to relieve the serious shortage of back shop facilities on the Baltimore & Ohio, which also includes a similar but smaller shop at Cumberland, Md. Prior to the construction of these two shops the main shop at Mt. Clare, Baltimore, Md., was practically the only plant capable of taking care of heavy repairs on the road and for some time it has been the practice of the road to contract with the Baldwin Locomotive Works for the handling of some of its heavy repair work.

Each of the new shops has a monthly output capacity in excess of any of the old shops on the system. Prior to the erection of the new shop the output at Glenwood was about 27 engines per month. The new shop, with space for handling 20 or 21 locomotives at one time, is expected to have a monthly output, when all the facilities are completed and the organization fully developed, of about 60 locomotives per month. These will include some heavy running repairs as well as the classified repairs for which the shop is designed. The output of classified repairs will probably run from 45 to 50 locomotives per month and under maximum output conditions the shop will employ a force of approximately 1,200 men.

NEW SECTION OF AMERICAN RAILROAD ASSOCIATION

The Executive Committee of the American Railroad Association has created an additional section, to be known as Section VI, to consider and report upon all questions affecting the purchasing, selling, storing and distribution of materials and supplies, and kindred subjects; and the section will include the former activities of the Railway Storekeepers' Association. In this section the representatives of the railroads will be officers of the purchasing and stores department.

J. E. Fairbanks, general secretary of the association, in circular No. 1949, has issued a tentative code of rules of order for the section, as approved by the executive committee. These rules, in principle and very largely in detail, are like those which have been adopted for the other sections of the association. The membership is divided into three classes, representative, affiliated and life. The present honorary members of the Railway Storekeepers' Association are to be continued as life members of section VI of the American Railroad Association.

The section is to be managed by a general committee of 16 elected members, and, in addition, during the period of federal control, of three representatives of the United States Railroad Administration, to be designated by the director of the Division of Purchases. The elected members must be divided equally between the purchasing departments and the stores departments; and during the period of federal control there must be two from each federal region, and two from Canadian railroads. The regular meeting of the section is to be held in May of each year, and at that meeting officers are to be elected.

The first general committee, which has been appointed by the executive committee, will organize the section and will serve until a regular election is held. This committee consists of the following:

H. S. Burr (Chairman), superintendent of stores, Erie Railroad.
E. J. Roth, manager, Stores Section, Division of Purchases, United States Railroad Administration.
S. Porcher, assistant director, Division of Purchases, U. S. R. A.
G. G. Yeomans, assistant director, Division of Purchases, U. S. R. A.
A. W. Munster, purchasing agent, Boston & Maine.
W. G. Phelps, purchasing agent, Pennsylvania Lines West of Pittsburgh.
E. W. Thornley, supervisor stores, Allegheny Region, U. S. R. A.
E. T. Jellison, purchasing agent, Chesapeake & Ohio.
J. P. Murphy, general storekeeper, New York Central (West).
H. C. Pearce, general purchasing agent, Seaboard Air Line.
H. H. Laughton, staff officer, Materials and Supplies, Southern.
G. E. Scott, purchasing agent, Missouri, Kansas & Texas.
W. A. Hopkins, supervisor of stores, Southwestern Region, U. S. R. A.
F. D. Reed, purchasing agent, Chicago, Rock Island & Pacific.
H. E. Ray, general storekeeper, Atchison, Topeka & Santa Fe.
F. A. Bushnell, purchasing agent, Great Northern.
J. E. Mahaney, supervisor of stores, Northwestern Region, U. S. R. A.
E. N. Bender, general purchasing agent, Canadian Pacific.
E. J. McVeigh, general storekeeper, Grand Trunk.

A meeting of the general committee was held on May 16 for the purpose of electing officers. H. S. Burr, formerly president of the Railway Storekeepers' Association, was elected chairman of the Section. E. J. Roth, formerly vice-president of the Storekeepers' Association, was elected vice-chairman of the Section, and J. P. Murphy, former secretary of the old association, was elected secretary for Section VI. Sixteen committees were organized to carry out the work of this section.

Cars Built in Railroad Shops.—During the month of March, 1919, there were constructed in railroad shops one steel underframe baggage car, 59 steel freight cars, 44 steel underframe freight cars, 131 cars with steel center sills and 249 wood freight cars, making a total of 484 cars for the month.

Fundamentals of Wage Payment

Variations in Results More Due to Variations in Management Than to Methods of Compensation

THE general abolition of piece work in railroad shops has confronted the managements of these shops with the problem of securing satisfactory output under a new set of conditions. In approaching this problem a clear understanding of the fundamental relations of supervision, labor incentive and labor output are highly desirable if what constitutes a satisfactory output is to be correctly determined and the conditions affecting its attainment properly controlled.

In an article by B. B. Milner, published in the Railway Age Gazette for April 25, 1913, page 952, these relationships

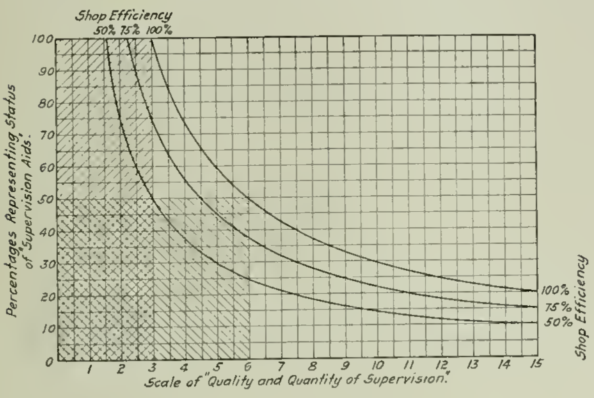


Fig. 1

were set forth in a discussion of the fundamentals of wage payment, the purpose of which was to indicate that all systems of labor compensation, including piece work and the various bonus systems, as well as the straight time basis, if properly administered, are more equally effective than generally supposed. What follows is based largely on the principles then set forth, to which the present situation has given added interest.

The real purpose of the piece-work system or of any of the other so-called reward systems of labor payment is to provide an incentive for the continued exercise of at least a satisfactory amount of skill and energy on the part of the workman. The prohibition now placed on all such systems of wage payment in railroad shops leaves to the workman only a portion of this incentive. It is evident, therefore, if satisfactory results are to be effected where piece work has been abolished, that their attainment becomes more largely a matter of administration, which involves the quality and quantity of supervision and assisting adjuncts provided by the management. Basicly, the problem does not involve the question of shop practice, or shop facilities, but is confined to the relative administration of the various systems of payment under the same physical conditions.

INCENTIVE VS. QUALITY AND QUANTITY OF SUPERVISION

To some it is difficult to appreciate how satisfactory output may be assured. To the incentive referred to—i. e., the ability to voluntarily increase the earning rate by increasing output—most workmen respond at least to the point of maintaining with a minimum amount of supervision their output, even under adverse conditions of shop service and facilities, if not always to the extent of actually increasing their output beyond that represented in a performance which workmen are morally bound to give and the employer has a right to expect under a day-work system. The loss of this incentive may be made up in quality and quantity of supervision and in the conditions and facilities which may be embraced under the general caption of supervision aids—those things outside of the supervising personnel making for the goal of highest efficiency represented by maximum output and minimum cost.

The efficiency obtainable varies with the adequacy of either or both the quality and quantity of supervision and the supervision aids, so that in order to maintain a selected or given efficiency, any loss in one of these items must be made up by an adequate increase in the other.

The principle of this relationship is clearly suggested by the chart in Fig. 1. In this chart note that the adequacy of supervision is relatively represented in the left-hand percentage scale from zero to 100, while the quality and quantity of supervision is represented relatively in the horizontal scale from zero to 15. Uniform efficiencies are represented by the efficiency curves marked respectively 100 per cent, 75 per cent and 50 per cent. These may be algebraically presented by the equation.

Shop efficiency = supervision aids × quality and quantity of supervision,

so that it will be seen that any loss in one of the latter terms must be accompanied by either (1) an increase in the other or (2) a loss in efficiency. For example, if with supervision aids at 100 per cent—that is, of such a character that no fault can be found with them—the resultant efficiency is 100 per cent, quality and quantity of supervision must be of a value arbitrarily denoted as 3 on the chart. If for any reason the value of supervision aids is disturbed by a reduction from 100 per cent to 50 per cent, the quality and

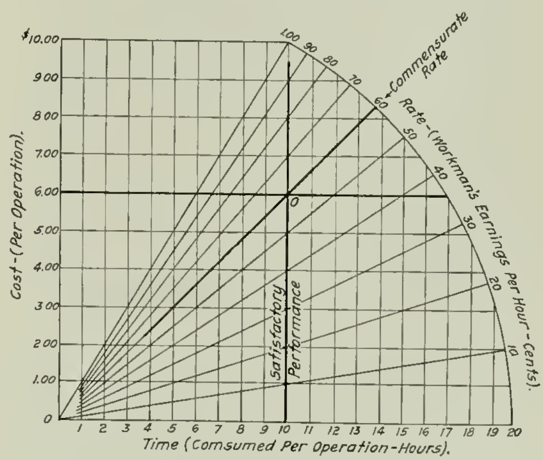


Fig. 2

quantity of supervision remaining constant at 3, the efficiency will also be reduced to 50 per cent, from which point, assuming the continuity of the lowered supervision aids, the efficiency can only be made to again approach 100 per cent by increasing the quality and quantity of supervision toward the value indicated on the chart as 6.

Careful consideration, therefore, of the two complementary factors entering into efficiency is important.

Quantity of supervision is a function of the number of workmen and the character of work to be supervised—i. e., whether unskilled or skilled, repetition or non-repetition work, operations standardized or unstandardized. The required quantity of supervision also depends on the quality of supervision available.

Quality of supervision involves the personal characteristics of foremen, their attitude toward men, their ability to plan and lay out their work, their genius as leaders of men, etc.

Supervision aids involve the general plan of shop operation, the variety of duties required of foremen, their clerical assistance, shop routing plans and their administration, records reflecting the individual performance of workmen; these should be susceptible of combinations reflecting the efficiency of groups of workmen, sub-departments and of an entire shop.

ELEMENTS OF ALL WAGE SYSTEMS

The concern occasioned by the alteration in the plan of labor payment seems to be based upon an erroneous idea of the differences in the relative efficiencies of the various labor payment schemes. All schemes or systems, properly administered, should bring approximately the same results. The fundamental and inter-dependent elements involved in any wage system are:

(1) The labor cost of production per operation (identical with the workman's earnings per operation).

(2) The rate of the workman's earnings per hour.

(3) The time consumed per operation.

These will hereafter be referred to as the cost, rate and time, respectively.

The time consumed per operation should be understood as that, not of the unusually skilful and rapid workman, nor the one lowest in the scale of skill and speed who is qualified satisfactorily to perform the work, but of the average work-

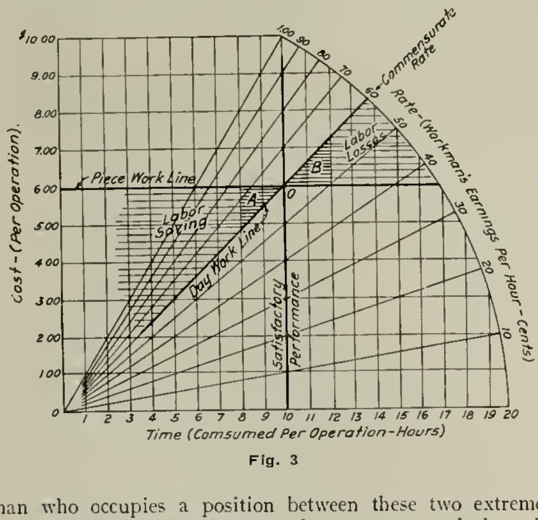


Fig. 3

man who occupies a position between these two extremes. The relations existing between the cost, rate and time elements are expressed by the following equation:

$$\text{Cost} = \text{Time} \times \text{Rate}$$

so simple in application that, having any two of these factors given, few workmen are unable to calculate the desired third. These same relations are presented advantageously by Fig. 2, which geometrically interprets the following equation:

$$\frac{\text{Cost}}{\text{Time}} = \text{Rate}$$

obtained from the previous equation by transposition. Within the range of values exhibited by the cost, time and rate scales, having given any two of these elements, the third may immediately be ascertained by inspection of the chart.

In order to be more specific, in the following development of the relatively small difference which exists in the efficacy of various wage payment systems when properly administered and the advantages which, though smaller than sometimes believed, obtains with the piece-work plan, an operation will be assumed, the satisfactory performance of which requires for ten hours of time the exercise of an amount of skill and effort for which the commensurate rate is 60 cents an hour, as shown by Fig. 2.

It should be understood that what constitutes "satisfactory performance" is prescribed by the management and varies with different managements. Once established for any operation it requires the exercise of a definite amount of "skill and effort" for a definite length of "time." The "skill and effort" required by the established standard of performance commands a commensurate "rate." The product of this "rate" and the "time" determines the equitable "earnings" of the workman and the equitable "cost" to the employer.

Fig. 3 is a duplication of Fig. 2, on which the characteristics of the piece work and the day work systems are represented. From this chart it will be seen that under the day-work system the employee does not participate in the value of labor savings accruing from increased output, as evidenced by the uniformity of his rate of earnings. On the other hand, he does not participate in any of the labor losses resulting from lower output, whereas, under piece work the employee enjoys the whole of the value of labor savings accruing from increased output, and sustains all of the losses which result from a decrease in output. Under the day-work system all labor savings or labor losses, as the case may be, resulting from increased or decreased output, revert to or are sustained by the employer, whereas under the piece-work plan these savings or losses are enjoyed or sustained by the employee, as the case may be. Furthermore, for the time corresponding to satisfactory performance under either system of wage payment, the cost and rate are identical. This situation cannot be disturbed without throwing out of balance the relations which must exist between the "time corresponding to satisfactory performance" and the workman's earnings expressed either as (1) a certain rate per hour, or (2) a certain fixed sum for the completed operation.

EFFECT OF VARIATIONS IN WAGE SYSTEMS SMALL

Between the two extremes represented by the day and piece-work plans there are many systems,—premium, bonus, profit-sharing, etc.,—which may be generally classed as divisional, because they are compromises under which the labor savings and losses resulting from increased or decreased output are divided between the employer and employee. The equity of compensation to the employee and of cost to the employer, in the case of all of them, is dependent on proper determination of the "time corresponding to satisfactory performance," since it will readily be realized that when such time is properly determined, along with the employee's hourly rate, the workman is not concerned in the plan under which he may be paid his compensation, so long as it is equitable and in correspondence with the skill and effort which he exercises. The employee complains justly when, under any system of payment, after having adequately fulfilled his obligation to exercise during a specified time the proper amounts of skill and effort, he fails to obtain his "commensurate rate."

All except unusual workmen, when honestly exercising that amount of skill and effort which they are bound or have agreed to deliver, will not vary much in their output from that represented by satisfactory performance and the time corresponding thereto. In other words, the honest performance of all except unusual workmen will fall within the range of the small triangles of Fig. 3, identified as *A* and *B*, for workmen exceeding and failing respectively to keep pace exactly with satisfactory performance. Since the workman must be paid the commensurate rate for satisfactory performance, regardless of the system of wage payment under which he may happen to work, the wage lines of all systems must pass through the point *O* and lie wholly within the triangles referred to.

It becomes apparent, therefore, that under uniform degrees of management efficiency the actual differences due to variation in wage systems are relatively small, and that any large variation in the efficiencies of operation under them must be due to variations in the efficiency of the methods and the management under which they are administered.

So far as the workman is concerned, the most vital factor in administration is the equitable determination of the time corresponding to satisfactory performance. Whether this time be used in the determination of a piece-work price, a bonus or premium system schedule, or the judgment of the supervising officer upon the matter of whether the workman has succeeded or failed to deliver satisfactory performance under day work, the determination of this time is all important. If it is low under the piece-work system, the resulting piece work price will inadequately compensate the workman. So also in the case of the bonus or premium plan, while under the day-work system, the workman may be unfairly criticized by the supervisor. If too liberal, an unfairly large piece-work price will result, which, according to experience under the piece-work system, is subsequently adjusted, i. e., lowered. These adjustments have caused discontent. The same is also true with regard to the bonus or premium schedules, while under the day-work system of operation, it results in a loosely operated, low efficiency shop.

The time consumed in the satisfactory performance of any operation under given conditions can only be determined from some sort of a time study. This is a very elastic term covering a wide range of precision and exactitude from that involved in, say, the gathering of information upon which to base a rough estimate of the time required for a day workman to mow a lawn, to that referred to by some as of the "blood-drawing type," involving the most minute stop watch data which has, in some places, been applied to the determination of working schedules. Workmen rightfully object to the latter, especially until all conditions and adjuncts of shop operation have been reduced to a degree of precision somewhat nearly consistent with the character of the time studies made.

PROBLEM WHOLLY ONE OF ADMINISTRATION

The fact that a reward system of payment is not used does not obviate the necessity of giving the time element any attention. Although not used directly in the determination of wages, the keeping of accurate output records must be of very significant value in connection with the day-work system; in fact, such records are essential to the maintenance of high shop labor efficiency. Such records form an essential part of the "supervision aids" previously referred to, which result in either (1) increasing the capacity of a given "quality and quantity of supervision," with respect to the number of workmen covered, or of (2) making it possible for the same "quality and quantity of supervision" to enhance the shop's efficiency.

The problem, therefore, is wholly one of administration, involving the provision of adequate supervision and of aids thereto, including shop records which may serve as a basis for measuring labor performance under the conditions and practices obtaining, for application to the individual workman, groups of workmen, whole departments, entire shops or to a number of shops collectively considered. To say that satisfactory outputs cannot be maintained under the day-work plan of labor payment apparently is to disregard the fundamental elements of the problem and their mutual relations.

It is, however, unreasonable with the day-work system, at a rate of, say, 68 cents per hour, to expect the exercise and delivery of the same amount of skill and effort within that hour, as under the piece work or any other reward system of payment, in which the workman actually earns a higher rate of compensation, say the equivalent of 90 cents or 95 cents for that hour.

IMPORTANT REVISION OF M. C. B. RULES

Circular No. 37 has been issued by the Mechanical Section of the American Railroad Association for the purpose of reestablishing delivering line responsibility and the practice of defect carding of car in interchange. The text of the circular is as follows: "This circular re-establishes delivering line responsibility and the practice of defect carding as between roads under U. S. Federal Control, and all circulars and interpretations to the contrary are hereby abrogated.

"In view of United States Railroad Administration Accounting Division Circular No. 86, issued April 15, 1919, effective the date of that circular, Articles 1, 2, 3 and 4 of the 1918 Code of M. C. B. rules for freight cars and modifications A to C, inclusive, of the 1918 Code of Rules for Passenger Cars are hereby abrogated and the following will apply to railroads under U. S. Federal Control:

"To the end that interchange inspection work may not be duplicated under U. S. Federal operation of railroads, so that more repair work and less unnecessary inspection will result, it is ordered—

"(1.) That joint arrangements shall be made to prevent such duplication in inspection by arranging all inspection forces at interchange points with a lead or chief joint inspector as conditions require, to supervise the forces and see that inspection and repairs are properly made to car equipment.

"(2.) M. C. B. Rule 2 is modified as follows: (a) Loaded cars offered in interchange (except those having defective safety appliances) must be accepted by the receiving line which may either run, repair or transfer lading from car; (b) the repairs to car or transfer of lading is to be done by the railroad having facilities nearest available. If facilities are equally available by both railroads, the car will be moved to facilities located in the direction car is moving.

"(3.) If car is shopped for repairs due to: (a) old defects that existed before car was loaded; (b) lading requiring transfer or readjustment, account of not being in accordance with M. C. B. loading rules; (c) overload requiring transfer of lading; (d) not being within clearance dimensions over route it is to pass; (e) not meeting A. R. A. third rail clearance. In each case above mentioned, the facilities nearest to car will be used in making repairs to car or transfer of lading.

"(4.) Should the location of facilities require a receiving line to make transfer or readjustment of lading, the cost of such transfer or readjustment of lading will be billed against the delivering line as per Rule 2 of the 1918 Code. The chief joint or lead inspector will make report and forward to the head of the mechanical department of both railroads, showing all cars transferred or shopped for old defects, whose duty it will be to impose discipline for willful and inexcusable violation of the M. C. B. rules of interchange and loading rules, the same as instructed in Director General's Order No. 8 for the violation of the safety appliance law.

"(5.) Cars, whether loaded or empty, having safety appliance defects will have such defects repaired immediately upon discovery and will not be offered in interchange. If necessary to move car to shops for repairs of safety appliance defects, it must be moved to shops of the company upon whose line it became defective.

"(6.) Empty cars offered in interchange, if in safe and serviceable condition, must be accepted.

"(7.) Bad order cars which previously had been delivered in bad order under load must be repaired by the road making transfer, if they have facilities and material; if not, the nearest repair point on any line, having material and facilities, should make the repairs.

"(8.) Owners must receive their own cars when offered home for repairs at any point on their line.

"Rule No. 92 is amended to read as follows: 'In rendering bills cars shall be treated as belonging to companies or individuals whose name or initials they bear, except that bills for repairs to leased cars or cars of other ownership shall be rendered direct if so directed in the billing instructions in the Official Railway Equipment Register.' "

ELECTRIC TOOL TEMPERING FURNACE

An electric tool-tempering furnace, which uses the barium-chloride and salt principle, is proving highly successful in the South Philadelphia works of the Westinghouse Electric & Manufacturing Company. The chief advantages of this type of furnace over those using gas, coke, oil or wood are constancy and ease of control of heat, cleanliness, equal heating of each atom of the specific part of the tool to be

Electric Tool Tempering Furnace Used by the Westinghouse Electric & Manufacturing Company

tempered, low cost of operation, and excellence of the finished work.

One of the photographs illustrates the simple construction of the furnace. The outer shell, a cast iron cylinder, is about 3 ft. high and 3½ ft. in diameter. This is packed with fire brick and an occasional layer of asbestos. The circular reservoir in the center which forms the operating part of the furnace is 12 in. in diameter and 14 in. deep.

The heat is supplied by two pairs of electrodes built in on opposite sides of the walls of the reservoir. The electrodes operate on a 16 to 30-volt alternating current circuit which is controlled by the switchboard and transformer shown in one of the illustrations. Carbon sticks are placed between the electrodes in the reservoir to complete the circuit.

The current is started on the 30-volt circuit. Salt is fed into the reservoir and when it is melted it acts as a conductor and completes the circuit. The carbon sticks are then taken out. A mixture of barium chloride and salt is then fed into the reservoir, the final proportion being about 60 per cent barium chloride.

When the temperature of the liquid reaches 1,425 deg. F. the voltage is lowered. The current regulation at the switchboard gives a quick and easy method of control so that the temperature of the liquid can be held at any predetermined degree of heat required for each specific tool.

The liquid, kept at one temperature, heats the tool uniformly from surface to center and eliminates soft spots in

Switchboard and Transformer for Controlling Alternating Current Supply to the Tool Tempering Furnace

the finished tool, which is seldom possible when a tool is exposed to a direct or indirect flame.

The furnace throws off very little heat, a feature which meets with the approval of the workmen.

Concrete Cars in the Netherlands.—The construction of concrete rolling stock for railroads is under way in Holland. Only the wheels, axles, buffers and couplings are made of steel. The weight of cars of the new type is said to be no greater than that of steel cars, the construction is simpler and cheaper and the upkeep light.

Electrification of Swedish Railways.—The Swedish State Railway Administration has published a statement to the effect that after investigations regarding the electrification of the entire Swedish railway system, it has come to the conclusion that the plan can be carried out in 30 years at a cost of 192,000,000 kr. The advantages of electrification are that the whole of the power needed can be obtained from eight Swedish electric power stations, the traffic capacity will be considerably increased, and a great saving in staff costs will be effected. Sweden's enormous water power will, in the first place, be made available for this purpose.

Air Brake Association Meeting

Record Attendance at the Twenty-Sixth Annual Convention; Brief Account of the Proceedings

The largest delegation of air brake men in the history of the organization gathered at the Hotel Sherman, Chicago, for the twenty-sixth annual convention of the Air Brake Association, which met May 6 to 9 inclusive. The first session was devoted to addresses by Frank McManamy, assistant director division of operation, United States Railroad Administration; W. J. Bierd, federal manager, Chicago & Alton; W. J. Patterson, bureau of safety, Interstate Commerce Commission, and F. J. Barry, president of the associtiion.

PRESIDENT'S ADDRESS

President Barry in his address spoke of the past work of the association and mentioned its recognition by the Railroad Administration as showing the general recognition of the progress that had been achieved through the leadership of the organization. He urged that the association should continue its efforts to improve air brake service and to extend its sphere of activity, particularly by more active co-operation with the local air brake clubs, which offer an excellent opportunity for keeping in close touch with the problems arising in the maintenance and operation of air brakes. In closing he paid a glowing tribute to the genius of Walter V. Turner, whose work has been largely responsible for many of the most important advances in the art of train control.

F. J. Barry (N. Y. O. & W.)
President

T. F. Lyons (L. S. & M. S.)
First Vice-President

L. P. Streeter (Ill. Cent.)
Second Vice-President

ADDRESS OF FRANK McMANAMY

Mr. McManamy emphasized the necessity for promoting safety, efficiency and economy in the operation of the railroads under present conditions and pointed out how the Air Brake Association can help to secure these aims. He spoke of the need for a realization of the fact that the air brake is not merely a safety device, but is essential for proper operation with the heavy motive power and long trains now in use. He mentioned also the part that could be taken in reducing damage claims by the proper maintenance of the air brake equipment.

Mr. McManamy stated that in his opinion the neglect of brake equipment was too common on roads with low grades and that steps should be taken to remedy the condition. He recommended increasing the forces employed on air brake work and installing proper facilities at repair points where the equipment is overhauled. As the first essential for proper operation he suggested that more attention should be given to stopping leakage in the air brake system and especially in brake cylinders and retainer valves. He spoke also of the co-ordination of the mechanical associations under the American Railroad Association and the benefit that the Air Brake Association could derive by having its recommendation referred to the Mechanical Section and issued as mandatory instructions.

ADDRESS OF W. J. PATTERSON

Mr. Patterson outlined the work of the Division of Safety as it affects air brake matters and spoke of the importance of improving general air brake conditions throughout the country. He advocated the universal use of the incoming brake test as a means of securing better conditions. He also referred to the fact that hand brakes are used to control freight trains when descending heavy grades and said that it was the intention of the Division of Safety to require such practices to be discontinued.

INSTRUCTIONS ON FREIGHT CAR BRAKE MAINTENANCE

A paper giving detailed instructions for the maintenance of freight brake equipment was presented by Mark Purcell (Northern Pacific). The need for clear and definite instructions in printed form was shown by the tests of cars shortly after cleaning, which demonstrated that 21.3 per cent of the brakes cleaned were ineffective within one month. Two years of special inspection and instruction work reduced the percentage to 8.8 which still left a big opportunity for improvement. The need for detailed instruction is particularly urgent at the present time because of the large number of inexperienced men employed in the air brake department.

To avoid unnecessary switching and loss of car service, work should be done well when the cars are sent to the repair track and every opportunity taken to ascertain the condition of the brakes when on the repair track, house track and transfer track. The installation of air lines at such points was advocated as a means of reducing the cost of brake maintenance, increasing car efficiency and expediting train movement.

DISCUSSION

The convention discussed at length the instructions for the testing and repair of certain parts of the air brake equipment, particularly with regard to brake cylinder leakage, retainer valve leakage and the lubrication of the brake cylinder wall. A special committee was appointed to pass on these questions and to prepare the instructions for publication as recommended practice of the association.

AIR LEAKAGE DUE TO DEFECTIVE HOSE COUPLINGS

A paper on Air Leakage and Money Wasted Through Failure to Keep Hose Couplings in Standard Gage, submitted by the Manhattan Air Brake Club, was presented at the Wednesday session of the convention. The paper emphasized the fuel waste due to brake pipe leakage and stated that examination of 1,600 freight cars showed that 35 per cent of the leakage existed in the hose couplings. Further investigation developed that it was difficult to find couplings in service that would pass the M. C. B. standard coupling gage test. Employees often use makeshifts to secure tight joints and at least one road has adopted a special gasket to eliminate hose coupling leakage. Some special types of gaskets submitted to railroads for approval when tested have required from 1,000 to 1,300 lb. to pull the hose apart. Such excessive strains fracture the hose and cause the brake pipe to shift, resulting in leakage. The paper recommended that the universal practice of gaging air brake hose couplings be included when periodic attention to air brake equipment is being given freight cars in shops or on repair tracks.

FUEL SUPERVISORS ADDRESSED THE CONVENTION

At the Thursday session L. R. Pyle and F. P. Roesch, fuel supervisors of the Central Western and Northwestern Regional Districts, respectively, delivered addresses in which they pointed out the way in which the air brake men could assist the Fuel Conservation Section. Mr. Pyle stated there has been a marked improvement in air brake conditions during the past few months, especially as regards brake pipe leakage. He urged the association to continue its support of the Fuel Conservation Section particularly by giving publicity to the magnitude of the waste of fuel caused by train line leaks. Mr. Roesch spoke of the necessity for reducing the cost of operation on the railroads now that normal conditions are being restored. As it appeared impossible to reduce wages or cut the cost of material, more efficient service was the only means of effecting economies that was left. He urged all the employees to justify the large increases in wages by greater efficiency in their work.

ADDRESS OF F. W. BRAZIER

At the Wednesday session F. W. Brazier, superintendent of rolling stock, New York Central Lines East, gave an inspiring address in which he counseled the younger members to devote their energies whole-heartedly to their work. He condemned the lax enforcement of the rules governing the maintenance of brake equipment to which he attributed in large measure the present unsatisfactory conditions. As an indication of the efforts the New York Central has made to maintain cars in good condition he cited the fact that as many as 800 men had been employed on air brake work alone and in 1917 the expenditure for freight car repairs had been over twice as much as for locomotive repairs.

OTHER BUSINESS

On Thursday morning a report was presented on damage to car brake equipment by thawing plants. The practice of thawing loads of coal and ore in buildings heated to a high temperature destroys the packing leathers, gaskets and air hose. The removal of the triple valves, hose and brake cylinder piston, before thawing, was recommended. No objection was raised to thawing by inserting steam pipes in the lading.

A paper was also submitted by the Northwest Air Brake Club advocating a braking ratio of 40 per cent and an inside release valve for caboose cars; the Central Air Brake Club also presented a report advocating large radiating surface between the compressor and the main reservoir.

The secretary reported a membership of 1,050 with a registration at the convention of 650.

The following officers were elected: President, T. F. Lyons, New York Central; first vice-president, L. P. Streeter, Illinois Central; second vice-president, Mark Purcell, Northern Pacific; third vice-president, G. H. Wood, Atchison, Topeka & Santa Fe; secretary, F. M. Nellis, Westinghouse Air Brake Company; and treasurer, Otto Best, Nathan Manufacturing Company. Newly elected members to the Executive Committee are C. M. Kidd, Norfolk & Western; R. C. Burns, Pennsylvania; H. A. Clark, Soo Line; and H. A. Sandhas, Central of New Jersey.

M. Purcell (Nor. Pac.) Third Vice-President

F. M. Nellis (Westinghouse Air Brake Co.) Secretary

Otto Best (Nathan Mfg. Co.) Treasurer

Eight-Hour Day in Italy.—Italian railway employees, according to a Havas press dispatch, have been granted by ministerial decree an eight-hour day with one day off in seven.

Automatics in Railroad Shops

Description of Typical Machines of the Three Primary Types; Set-Ups for a Variety of Jobs

BY M. H. WILLIAMS

On many railways it is found advantageous to blank out articles to a finished or semi-finished state in one central shop and ship them to other shops, a practice which results in economy when compared with manufacturing in each shop. The good results obtained with the automatic screw machine put it in a class that should be carefully considered when additional machine tool equipment is contemplated. This class of machine is being introduced into railway shops and is generally meeting with favor. Its field lies in the manufacture of smaller articles used in locomotive and car construction and repairs, such as are required in larger quantities than would be economical to make on turret lathes.

Contrary to general expectations, no serious difficulty has been encountered in operating these machines and it has not been found more difficult to secure operators for them than for the average run of machines generally used. While it is true that a certain amount of special talent is necessary for successful operation, in most shops there will be found one or more universal geniuses who will take naturally to machines of this nature and who with encouragement and a few visits to plants where similar machines are in operation will become experts and capable of camming, setting up or arranging for any work required. Where one expert is employed the machines may be run by operators who have not had extended experience. The operators rapidly acquire the knowledge necessary to set up and run these machines, one of the principal requirements being the grinding and setting of cutting tools, which is about the same as grinding and setting tools used on turret lathes.

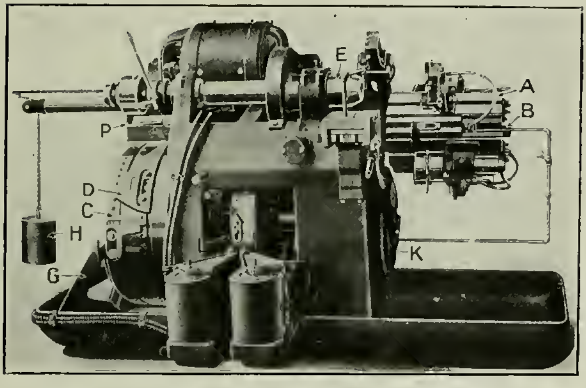


Fig. 1—Typical Single Spindle Automatic Turret Lathe

The economy of the automatic screw machine as compared with the turret or center lathe is due to the fact that one operator can run from two to four machines, each of which will turn out work as rapidly as a turret lathe and much more rapidly than a center lathe. The automatic screw machine is quite similar to the turret lathe, with the difference that on the automatic machine the various operations are controlled by cams and on the turret lathe by hand.

The machines best suited for the first installation in railway shops may be divided into three classes: the single spindle machine suitable for bar work, in which one bar is worked on at a time, Fig. 1; the multiple spindle machine, on which four or more bars are worked on at one time, Fig. 2; and the automatic chucking machine, Fig. 3, having one spindle and used mostly for machining castings and forgings.

The machines illustrated have been selected as representative of their class and for the purpose of explaining the general principle of operation. There are several makes and designs that are extensively used, all of which, together with those illustrated are very popular. Selection must necessarily be governed by the volume of work a particular shop is called on to turn out, cost and other considerations. The kind of work suitable for each class of machine and the general principles of operation and set-up will be considered separately.

THE SINGLE SPINDLE MACHINE

This class of machine, shown in one form in Fig. 1, is very useful for railway work on account of the ease with which it may be cammed and tooled, or as it is generally termed "set up." For the small batches of articles, such as valve motion pins and bushings, set screws, bolts or cap screws having finished surfaces, boiler patch bolts, turned air brake pins and similar articles, this machine will be found very desirable for work made in too large quantities for economy on turret lathes and in too small quantities to justify setting up a multiple spindle automatic.

The machine which is shown in Fig. 1 is motor driven,

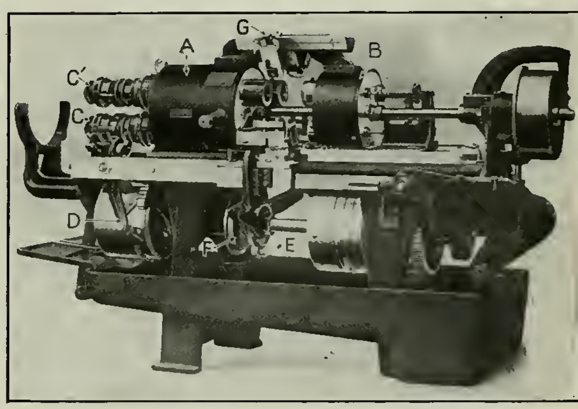


Fig. 2—Multiple Spindle Automatic Screw Machine

and practically all classes of automatic machines may be driven by motor, which is generally considered an advantage. There are several designs of single spindle machines on the market, all of which work on one general principle, therefore, a description of the machine shown will be for the purpose of explaining the various operations. This description will apply in a general way to any single spindle machine.

This type of machine generally has a four hole or face turret to which the various cutting tools, dies or tap holders, shaving tools, etc., are secured. To those accustomed to turret lathe practice four tool holders may not appear enough. In practice it is found ample on account of combining several cutting operations in one tool holder, as will be brought out later. On the machine shown the tools are held on a four sided horizontal turret that is indexed from one position to the next in succession as each tool is required, the active tool being at the top. Each tool is mounted on a slide that is moved to the left by cam *D*. Fig. 1, secured to the cam drum at the left of the machine. This cam works on a roller attached to a rod which connects with whatever slide is at the top, the slide being moved back to the right by cam *C*, also acting on the roller.

Other forms of machines have a round turret revolving around a vertical shaft similar to turret lathe construction, while others have round turrets revolving around a horizontal shaft. On all of these machines the turret and slide are moved to the right and left by cams acting on a roll secured to the turret slide. When the turret is moved to the right it is indexed to the next position.

The cam shaft shown in the lower frame on this machine, and the corresponding cam shaft on practically all single spindle automatic machines, makes one complete revolution for each piece manufactured. To the cam drum or cam disks secured on this shaft the various cams for controlling the operations of the machine are secured. This cam shaft is driven on the belted machines by a separate belt, the pulleys or gears being changed to obtain different speeds. On motor driven machines the speed is often changed by rheostatic control. An explanation of the uses for the various cams will be made in order to give an idea of the work involved when changing from one job to another and not for the purpose of explaining the design of the cams.

With the machine shown in Fig. 1 the slide on the turret face is made to travel in a horizontal direction by cams *C* and *D*, mounted on the left hand drum, working on a roll secured to bar *B*. The cam *D* is for feeding the turret slide up to and over the work and cam *C* for the reverse direction, the length from the right to the left hand side of these cams being sufficient to cause the turret to travel the maximum length the machine is designed for. With the machine in question the turret is indexed by separate mechanism. On other forms the indexing is done when the turret is at its extreme right hand travel, similar to hand screw machines. Cams *F*, F^1 (at the right, but not shown in the illustration) on the same drum are for tightening and loosening the chuck or collet, forcing the spring collet into the inclined spindle head or nose *E*. This does not differ to any great extent from turret lathe practice. The cam *G* on the same drum is for feeding the bar, and in this case the cam draws the feed tube backwards over the bar, the weight shown drawing on the chain which forces the feed tube to the right and feeds the bar as soon as the pin *P* passes over the peak of the cam. The cam disk *K* at the right of the machine is cammed to operate the front and rear cut-off tool holders. The middle drum has cams *N* and *O* (one of which is not shown) for controlling the direction of the rotation spindle. The pins *L* on this drum are for controlling the speed of rotation of the cam drum shaft and perform the following operation.

The speed of rotation of the cam drum must of necessity be slow while the tools are cutting. In order to increase output a speeding-up arrangement is applied to the cam drum driving mechanism, by which the speed of drum rotation is very much increased, often 70 to 1, and which causes the machine to go through the non-cutting operations, such as the travel over the surface of cutting cam *D* previous to the tools in the turret coming into operation, backing off and indexing the turret, feeding stock, etc., at a rapid rate. When tools are cutting the speeding-up device is non-operative and the cam shaft travels at a slow rate. This device performs practically the same operation as the operator on a hand screw machine, who after a cut is completed quickly backs off the turret to the rear position for indexing and bringing it up to the work. The speeding-up device is controlled by pins *L* bolted into a groove cut in the side of the cam and may be readily altered by simply loosening and tightening a nut. This makes it possible to eliminate lost time between cutting operations and to do practically the same as the operator does on the hand screw machine.

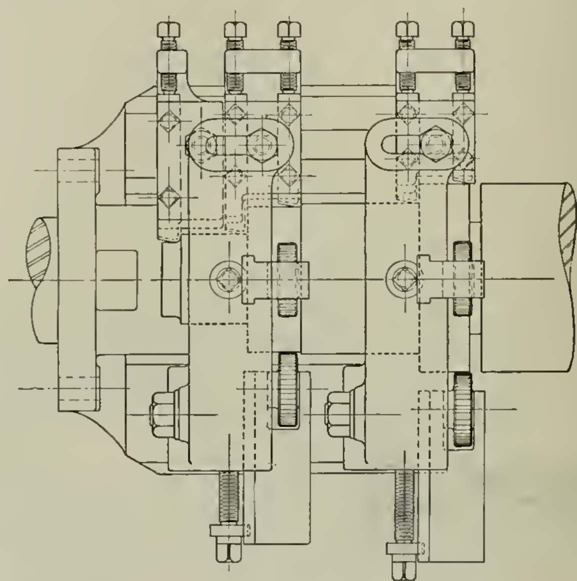


Fig. 4—A Box Tool

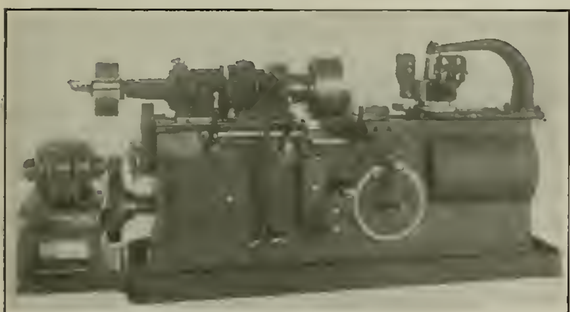


Fig. 3—An Automatic Chucking Turret Lathe

SETTING UP A NEW JOB

The cams for the two cut-off rests bolted to the right cam disk *K* do not require much changing for different jobs, as cutting off is generally the last operation. For some work it is necessary to form with one of these cut-off rests before the piece is ready to cut off, which will make a change of cam necessary.

The cams for feeding the stock and chucking on the drum at the left are generally permanently located and are rarely altered. The reversing cams *N* and *O* for rotation of the spindle must be altered when tapping operations are performed or a solid die is used. This operation is readily performed by removing the bolts and setting to new location. The cams or pins for the hurry operation *L* must be changed for each job. This requires only the loosening and tightening of a nut. The cams for feeding the turret will be considered later.

The tools used on the single spindle machines are comparatively simple, not differing greatly from tools used on hand screw machines or turret lathes. The principal tool for average work is the box tool in some of its forms, one form being shown in Fig. 4. These tools are well understood by those familiar with hand screw machines or turret lathes. On the automatic it is customary to make use of a number of cutting tools in one box in order to turn to various sizes and shoulders in one operation. These tools are found convenient of adjustment for various sizes and shapes of work. The cut-off tool, drill and reamer holders and forming tools are very similar to those used on turret lathes. The die holder may be similar to that used on turret lathes, but the self-opening and closing die is generally preferred, the machine and die being arranged to open and close at the right moment. All these tools are regularly supplied by the makers of the machines.

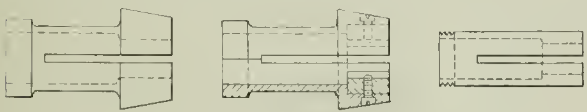


Fig. 5 Fig. 6 Fig. 7
Spring Collets and Feed Finger

For each size of stock it is necessary to use the correct size of spring collet, as shown in Fig. 5. Those for the smaller machines are made from one piece of tool steel very accurately machined and split as shown. They are then hardened and ground to the correct size in the bore where the stock is clamped and also on the outside where they fit the chuck nose. This is a somewhat difficult operation, requiring experience and proper appliances, and can best be done by the makers of the machines. For the larger machines a spring collet or holder is used into which pads may be held by screws, as shown in Fig. 6. With this arrangement one or two holders will answer for any size of bars within their range. It is necessary, however, to obtain pads for each size and shape of bar.

The feed fingers shown in Fig. 7 are made similar to the spring collets. For the smaller machines they are solid and for the larger machines are used with pads. These, like the two forms of spring collets, can best be purchased from the makers. The collets and feed fingers will last a long time and are not an item of great expense. It is necessary to use collets made correctly for each size of round, square or hexagon stock, as their range for satisfactorily holding bars is rarely 1/32 in. and unless properly made it is not possible to obtain satisfactory work or output.

CAMMING FOR AVERAGE JOBS

Before going into the question of the laying out of cams it may be well to consider the conditions of camming and set-up generally found in railway shops, having in mind such work as may come within the range of the class of machines in question.

When purchasing a machine it is customary to have the maker cam it for one or more jobs and also supply an entire equipment of tools for the more common pieces to be made, the result being that the machine is received set up in the most approved method and will be an object lesson in the art of camming. After obtaining a few machines properly cammed it is surprising how many jobs may be done without changing cams, and how quickly changes may be made from one job to another. As previously pointed out, the cams for feeding and chucking the stock rarely require changing; the speeding up cams are set by altering their position with a wrench; the cut-off cams do not require frequent changes. It then comes down to the feed cams for the turret, which will have to be changed when a radical change is made in the class of work.

Assume that a machine has been purchased set up to make cup pointed set screws, say 3 in. long and ¾ in. in diameter, made from ¾-in. square stock, as shown in Fig. 8. A possible set-up would be as follows: The tools used in the turrets could be made up of a stop for limiting the length of bar fed out, a box tool to turn the threaded portion of the screw and at the same time reduce the pointed end, a drill to cup the point, and a die for threading. A tool would be placed in the front cross slide to break off the corners of the head and neck under the head and the cut-off tool in the rear or top cross slide. For holding the stock a collet having a ¾-in. square hole would be used and also a feed finger having a similar hole.

The cycle of operations is as follows: The feed finger is pushed forward to the right by the weight and carries the bar until the end of it strikes the stop set on the turret, which arrests its travel. For this operation the feeding and cams controlling the left hand travel of the turret must be set so that the stop meets the bar at the right moment, it being customary to design the stop cam with a short straight surface, which will allow the turret to remain stationary while the bar is feeding and the chuck is closing. The cam for the collet chuck now forces the collet tube forward, which causes the collet to close on the bar and lock. The turret is now forced to the right and is indexed to the next position by one of the backing off cams *C*, Fig. 1. It is then caused to travel to the left by work cam *D*. All of these operations are performed with the cam drum revolving at a rapid rate by the adjustment of the speeding-up device. When the box tool is within about ⅛ in. of the end of the bar the speeding up device is thrown out of operation by the speeding pins *L*. The turret then travels at a speed suitable for taking a cut with the box tool, which then machines the threaded body of the screw and also reduces the end and points. After this operation is completed the speeding up device is set in operation and about this time one of the reversing cams backs off the turret and causes it to go through the same operation as has been explained until the drill is about ⅛ in. from the point of the screw. The cam drum then again slows up until this operation is completed.

Threading is done in identically the same way. If a solid die is used the spindle of the machine would be reversed at the proper moment by the cams for that purpose. The cut-off cams then cause the tool for breaking off corners of the head to feed in and do its work, and also at the same time the cut-off tool is cutting off the bar. When the set screw is completed it falls into the base of the machine or onto a chute and drops into a box. The cam drum now goes to fast speed, the chucking cam loosens the collets, the bar feeds, and the various operations are gone through again.

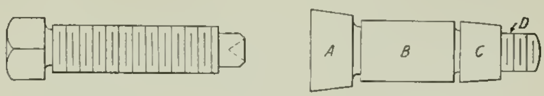


Fig. 8 Fig. 9
Cup-Pointed Set Screw Valve Motion Pin

The set-up just described could be modified to save time by holding the drill for cup pointing in the box tool, in this event the turning and cup pointing would all have been done at one time and the separate operation of cup pointing done away with; the third position of the turret could thus be passed over while the cam drum is revolving at a rapid rate.

Set screws are required of various lengths and diameters for locomotive repairs. If necessary to make to lengths differing from that mentioned above the operations of altering the machine would not differ greatly from those of changing a turret lathe. To change from the 3-in. screw above mentioned to a 2-in. screw will require the following changes. The stop for gaging the length of stock must be set out one inch, the cutting tool in the box tool for reducing the point adjusted, the drill for cup pointing moved out one inch and the speeding-up cams or pins relocated to throw the same out of operation at a later period, all of which may be done in a few moments. If it is necessary to make a longer screw the cutting tools would be reset in the opposite direction from that mentioned and the speed-up pins reset. For manufacturing bolts from hexagon or square stock it would be necessary to change the collets and feed fingers and alter the tools on the turret faces. The cams used for

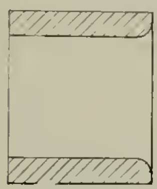


Fig.10
Rod Bushing

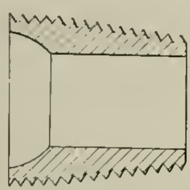


Fig. 11
Staybolt Sleeve

set screws would answer without changing. Shifting from set screws to bolts will involve about the same work as changing on a turret lathe.

A NUMBER OF TYPICAL SET-UPS.

Next it may be well to consider work such as valve motion pins or bolts, as shown in Fig. 9. This pin may be made from cold or hot rolled mild steel of the nearest diameter kept in stock. The cycle of operation of manufacture would be as follows: The stock would be fed out against a stop and the collets tightened. Next a box tool would rough turn the diameters *A*, *B*, *C* and *D* as shown in Fig. 9, except that the tapers would not be made in this operation. For roughing these four diameters four cutting tools would be placed in the box tool, each set to cut to the proper diameter and correctly spaced to allow for the correct distances. The next tool may be a finishing box tool in which are held two broad faced shaving tools for shaving the taper portions, a plain tool to turn the body *B* to correct diameter and also a center drill for centering the end of the pin. The remaining turret face would be taken up by the threading die. In the front cut-off rest would be placed two tools for necking, as shown, should this be desired, the cutting off being done by the rear cut off.

The stop, chucking and feeding cams would be identical with those used for the set screw. Under most conditions the same work cam *D* would be used. However, on account of heavier work and more tools cutting it may be desirable to alter this cam to provide a slower rate of feed, which would involve removing the two bolts shown, removing the cam and applying a new one. A reasonable amount of care must be taken to locate the new cam similar to the one removed. The same operation would possibly also be necessary for the next cam, on account of the center drilling, which is a delicate operation; it may be desirable to reduce the angle of the cam near the end of the cut in order not to crowd the drill. The operation of threading would be similar to that on the set screw. The cut-off cams would be the same. The speeding up cams would be set to speed up at completion of each cut and slow down at the start of each cut, as has been explained.

As another example let it be assumed that it is desirable to make bushings such as are used in valve motion levers or rods, shown in Fig. 10, from solid bar stock. The operations of feeding the bar would be similar to the above. In the second position of the turret the operations would be those of drilling and rough turning the outside, both of which may be done at one time by a drill and turning tool held in the box tool. If accuracy is desired, an inside and outside turning tool may be used on the next turret face, inside turning of the hole being for the purpose of insuring that the hole is concentric with the outside and to correct trouble from the drill not running true. If accuracy is not necessary, as would be the case where these bushings are to be finished later to fit worn levers, this operation may be omitted. The next operation would be that of reaming the hole and cutting off. On account of the drilling which may be for a comparatively large hole, it will be necessary to employ a slow feed work cam *D*, Fig. 1, the changes of which would be similar to those previously explained.

For making flexible staybolt sleeves, Fig. 11, the operations may be those of drilling and forming the outside at one time, threading the taper end and, in the last position of the turret head, threading the straight portion and cutting off. This would require a slow feed cam for the drilling and require relocating the cut-off cam for the outside forming, which should be done at the same time as the drilling. This will involve in most machines the drilling of additional holes in the cut-off cam disk. The threading could be done with the regular work cams. On account of two dies it would be necessary to add a pair of cams to take care of the second reversal of the spindle, and the speeding-up cams would also have to be properly set. This describes only one of the many methods of setting up for this much used article. In the larger shops it is customary to make these sleeves on multi-spindle automatic machines, where the output will be greater. The countersinking for the head of the staybolt must be a second operation.

Much space could be used in dealing with the proper angle and design of cams in order that the greatest output may be obtained. On this class of machine it is the custom of the makers to supply cams known as slow, medium and fast, which will generally meet all requirements for railway work. To go too deep into this phase of the subject would only complicate matters and it is a question if anything would be gained in the long run.

When purchasing a machine it is customary for the maker to cam for certain jobs. From the original set-up a study of cams and tools may be made that will serve as a guide for future jobs of a similar nature. That is, suppose a machine is set up for the set screw, Fig. 8, where the cam for feeding the box tool is what is known as medium, or in the case of the bushing, Fig. 10, a slow cam is used for drilling the bushing. If these work satisfactorily a record may be made of the set-up and similar cams used for jobs of a similar nature. By obtaining a supply of cams of various degrees of speed about any job encountered in railway shops may quickly be set up. The cams used on most single spindle machines are made of iron or steel castings and are comparatively cheap. While the speed of output may not be all that an expert may desire the results for the month will be found satisfactory if attention is given to reducing the lost time by proper setting of the speeding up device for the cam drum.

Making use of as many cutting tools in one operation as possible results in time saving. Never make use of two faces of the turret if by combining the tools the operations may be done on one face. This is a question of judgment on the part of the employee having charge of the machine.

The single spindle machines are made in various forms and designs, having rod capacities of from ¼ in. to 5 in.

For railway work, except in the largest shops, there is not enough work to keep the smaller machines fully employed. As a general proposition machines smaller than 1½-in. rod capacity will not meet with favor. However, the general run of work must govern the size of machines selected.

THE MULTIPLE SPINDLE AUTOMATIC MACHINE

The multiple spindle automatic machine, shown in Fig. 2, differs from the single spindle machine in that four or more bars are operated on at one time and as a result a greater output is obtained. Its principal use is for making articles in large numbers at one time; it begins where the field of the single spindle automatic machine leaves off.

The machine shown has four live or work spindles and will serve as an illustration for describing any class of multi-spindle machine, some forms having five or six spindles. However, they all work on one general principle.

With the machine shown, each of the four bars when being worked on is chucked and revolved in one of the work spindles C, C^1, C^2 and C^3, only two of which are clearly shown. These spindles have their bearings in a drum that is indexed on the quarters. That is, the spindle shown at C next indexes to position at C^1 then to C^2 and so on. The stock is always fed and chucked in the spindle while in position C, the operation of feeding stock and chucking being controlled by cams on the cam drum D. These operations are similar to those of the single spindle machine.

The turret, or more properly speaking, the fixture for holding the cutting tools, dies, taps, etc., is shown at B. This is mounted on a slide that works longitudinally in a horizontal plane and is controlled in its movements by a roll attached to it, which is operated on by the cams on cam drum E, the number of tools in this tool holder corresponding to the number of spindles of the machine. The cut-off and cross forming tools are controlled by cams on cam disk F. There are also special shaving tools at the top of the machine shown at G.

HOW THESE MACHINES OPERATE

When setting up this machine a bar is passed through the spindle shown at C and the chuck and feed finger properly set. The machine is then indexed by hand to the next position, so that this spindle is rotated to position C^1. The second bar is then placed in the spindle now at C and the chuck and feed finger for this spindle properly set. The same operation is gone through with for the remaining two spindles. The machine may then be started, when all spindles and bars will revolve.

When machining, the four tools in the turret each performs a certain operation very similar to the single spindle machine, except that with this form of machine the first tool performs a certain operation, which for the set screw may be to turn the threaded portion for a part of its length. The live head then indexes and this bar is passed on to the next tool, which may finish the turning and pointing. In the meantime the bar just fed is having the first operation performed on it. The head then indexes and the first bar is threaded and the second and first bars are turned. In the last position the bar is cut off. It will be noted from the above that each time the tool holding turret advances a complete piece is made, the time to make a piece being that of the longest single operation. The method of setting the tools is very similar to the single spindle machine.

The operation of indexing the live spindle drum, threading and revolving the live spindles would require a lengthy description and will therefore be omitted; suffice it to say that these operations have been carefully worked out and give very little trouble.

The cam drum shaft makes one revolution for each piece manufactured, that is, the cam drum makes four revolutions to one complete revolution of the live spindle drum. The cams are very simple, consisting of the customary cams to open and close the chuck and the bar feeding cams, which are mounted on cam drum D. Like those on the single spindle machine, they are rarely changed. The tool turret is controlled by cams mounted on cam drum E, which are generally changed when a job is set up, which varies to any great extent from the previous job, this being done to obtain greater output. The cut-off cams on disk F do not require frequent changing. In addition, the machine has the customary speeding up device for rapidly revolving the cam drum during the non-cutting operations.

As a whole this class of machine is not difficult to set up and is readily understood by persons having a knowledge of automatic screw machines in general. It is naturally more difficult and more time is required to set it up than the single spindle machine on account of the greater number of chucks and feed fingers that are used, each of which must be adjusted to the correct tension. The cutting tools do not differ greatly from those used in the single spindle machine and require about the same time to set up. With the multi-spindle machine it is necessary to employ one set of chuck and feed fingers for each spindle, amounting to four or more sets compared with only one for the single spindle machine. On this, as on the single spindle machine it is often possible to change from one job to another without changing the cams or, possibly only a change of the cam that controls the tool holding head.

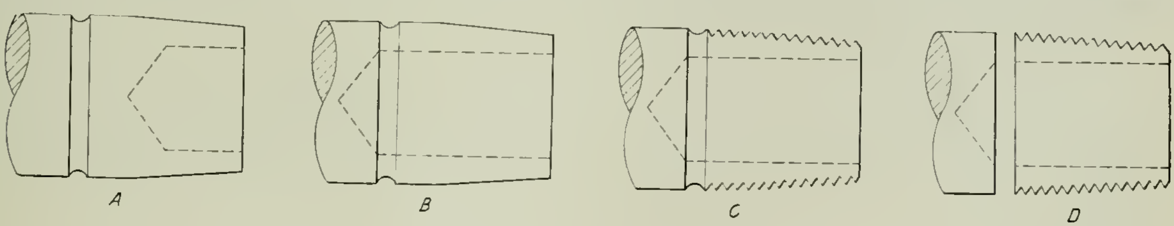


Fig. 12—Successive Operations in Making Sleeves for Flexible Staybolts

SOME MULTIPLE SPINDLE RAILROAD SHOP JOBS

In railway shops there are a number of articles that can be made to good advantage on these machines. Their selection should be confined to articles made in large quantities where frequent changes or set-ups will not be necessary. One job these machines are often used on is the making of sleeves for flexible staybolts, as shown in Fig. 12. A description of the different operations when making this piece may be of interest and will serve as an illustration for any similar job. Assume that the four bars are in the machine and ready to start. The bar in position C is fed against a stop that is moved up in front of the bar at the time of its feeding. After the bar has been tightened in the chuck the stop lowers out of the way. The cutting tools then advance to the left and drill a hole for a part of the distance and at the same time a front forming tool is cutting the outside of the bar to the form shown at *A*. When this operation is completed the tools back away and the spindles are indexed a quarter turn. The second bar is now fed in the spindle in position *C*. The bar previously mentioned has now advanced to the next position, where the hole is drilled the full depth by a second drill, as shown at *B*, and at the same time the bar just fed is drilled and formed on the outside. The tools now back off and the third bar is fed and chucked. In this position the first bar is threaded, which for this particular piece is done by two dies held in one holder, one being for the straight thread and the other for the taper thread, as shown at *C*. While the threading

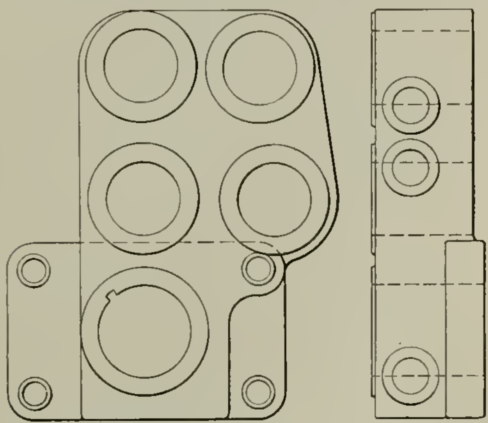


Fig. 13—Turning Tool Holder

is going on the two operations explained are also going on on the bars following. The tools now back off and the first bar indexes to the fourth position, where the sleeve is cut off, as shown at *D*, and at the same time the operations that have been explained are being performed on the succeeding bars. As a result, each time the tools advance a complete piece is made. If it is necessary to make a longer or shorter sleeve the cutting tools and speeding dogs should be changed. A change to a larger or smaller sleeve will also involve changing collets and feed fingers, but for the average length

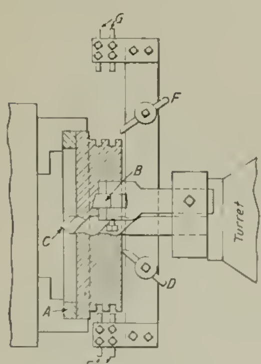


Fig. 14

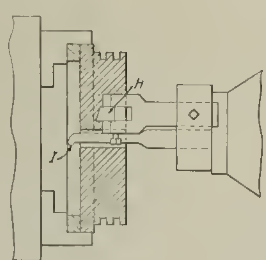


Fig. 15

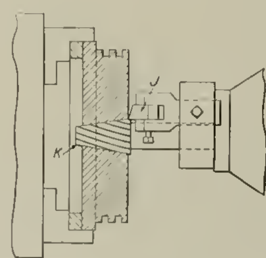


Fig. 16

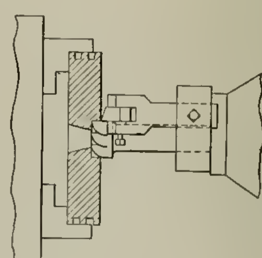


Fig. 17

Operations in Turning an Air Pump Piston Head

of these sleeves it would not be necessary to change the cams. To make set screws or similar articles would probably require a complete change of collets, feed fingers and cams on the drum for feeding the tool slide.

THE AUTOMATIC CHUCKING MACHINE

The automatic chucking machine, shown in Fig. 3, is used mostly for machining castings and forgings. It differs from the automatic screw machine principally in the omission of automatic chucking and feeding of the stock, the turret travel and indexing, the cut-off, forming and speeding-up of the cam shaft being operated by cams. The articles to be machined are chucked in regular lathe chucks or special chucks or holders and follow practices very similar to holding castings or forgings in center lathes.

In operation the piece to be machined is chucked and a starting lever is shifted which throws the cam shaft revolving mechanism into operation. The machine then goes through the various operations necessary to complete the piece, being controlled entirely by the cams. When the piece is completed the mechanism for revolving the cam shaft is thrown out of operation and remains inactive until the operator adds a new piece and starts it again.

The method of camming and setting up this form of machine is very similar to that used on the single spindle automatic screw machine and a description would be largely a repetition of what has already been said; therefore this will not be considered except where it is necessary to note differences.

CAPACITY RANGE OF CHUCKING MACHINES

These machines are made in various sizes and forms, the largest being capable of machining work up to about 16 in. in diameter by about 12 in. long. Their principal use in railway work is the manufacture of special cocks and valves used on locomotives, air pump piston heads and packing rings, nuts for side and main rods, oil or grease cups made from forgings or castings, parts for metallic packing, water gage parts, boiler fittings, piston rod and other nuts, piston packing rings and parts, nuts for flexible staybolts, knuckle pins and bushings, or generally speaking, any article finished from castings or forgings within the size capacity of the machine, which are made in quantities of 50 or more at a time.

The tools used on these machines differ materially from those used on automatic screw machines, principally because the work is larger and made from castings or forgings. These tools in many respects resemble those used on the larger turret lathes for similar work. When the machines are purchased they may be equipped with various forms of tool holders, turning tools and devices, which make it possible successfully to machine a large variety of work without designing special tools. The cutting tools are generally made from square high speed steel, similar to the bits used in lathe tool holders.

One form of turning tool holder, shown in Fig. 13, is used quite extensively. This, as shown, may be secured to the face of the turret by four bolts, the outer face being drilled and reamed to take tool holding bars such as those shown in Fig. 18, which in turn hold the high speed cutting tools. The holes for the tool holding bars are spaced to varying distances from the center line of the lathe spindle, which makes it possible to select a hole suitable for practically any article to be made. It is customary to make use of one, two, three, or more of these holes and tool holding bars at one time, in order that a corresponding number of cutting tools may be in operation at one time, each machining a separate diameter or face. A good illustration of this is the valve bonnet shown in Fig. 21, where the shoulder, threaded portion and end are all machined at one pass of the turret. Drills and reamers are held about the same as in turret lathes. It is customary to use the self-

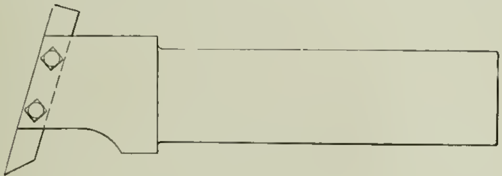


Fig. 18—Outside Turning Tool

opening die, as these machines are not usually arranged for reversing the direction of the spindle, and collapsing taps are also used for the same reason. These dies and taps give very good results. The cross facing is done with ordinary tools held in tool posts similar to lathe practice. Special tool holders and appliances are designed for various jobs, making it possible to machine almost any article required that comes within the range of the machine. It is a question of having a large enough run of one kind of article to warrant the designing and making of these special appliances.

TYPICAL CHUCKING MACHINE WORK

A few illustrations will be given showing jobs suitable for the machine in question. A fair sample of larger work is the 9½-in. air pump piston head, Fig. 14. There are numerous ways this job could be set up. For the comparatively small number called for at a time the set-up as outlined below may be followed and is advocated because it will involve only a few tools in addition to those which would be required to make the same piece on center lathes. The casting would be chucked for the first operation, as shown in Fig. 14, having it supported as far away from the chuck face as possible while assuring a satisfactory hold and permitting the entire outside face to be machined at this one chucking. It is backed up by ring *A* to prevent shifting and admit of quick chucking. The tool *B*, for turning the periphery of the head, and the drill *C* are held in a tool holder secured to one face of the turret. As the turret advances the drill bores the hole for the piston rod and the outside is rough turned. As soon as these operations are completed far enough for the tool holders and turret to get out of the way the front facing tool *D*, held in the cross slide, starts to rough face. Generally the cams may be set so that these two operations are going on at one time. In the front cross slide are also held two tools, *E, E* for roughing out the grooves for packing rings and which come into operation about the time the facing is completed. The front cross slide now backs off and the rear slide, in which are set a finish facing tool *F* and two finishing tools *G, G* for packing ring grooves, comes into play and completes these operations. These latter tools are held with the cutting edge downward. These now back off and come to rest to clear the casting. The cam shaft now goes into high speed and causes the turret to index and advance until the tools are about ¼ in. from the work when the cam shaft goes to slow speed and the finishing tool *H*, Fig. 15, finishes the outside diameter of the casting to correct size and at the same time a boring tool *I* bores the hole true for the purpose of correcting any inaccuracies that may have developed on account of blow holes or the drill not running true. The cam shaft now goes to fast speed and indexes the high speed continuing until the tools shown in Fig. 16 are ready to cut, when it slows down and tool *J* in the tool holder breaks off the corner while at the same time the hole is reamed by reamer *K*, held in a floating holder. When this is completed the cam shaft goes to fast speed and indexes around to the starting position, where it automatically stops, until the finished piece is removed and replaced.

The second side is finished in a very similar manner, as shown in Fig. 17, the front facing tool, in the cross slide shown in Fig. 14, the rear facing tool rough facing the piston, while the rear tool does the finish facing. A tool in the tool holder on the turret breaks off the corner. If necessary to counterbore for a piston rod nut, a counterbore is also held in the turret and operates at the same time. The second side of these pieces only takes up one face of the turret, the remaining faces being indexed and passed over at fast speed until the machine comes to starting position.

This set-up, while not ideal for great output, is one that may quickly be made without much in the way of tools not supplied with the machine. The two front and back tools to cut the packing ring grooves require a special holder which is not expensive. The facing tools are held in regular toolposts on the cross slides which may be supplied as part of the machine.

The cutting tools are similar to lathe tools used for similar purposes. The drill is held in a holder in one of the turret holes, the inside turning tool being held in a similar manner. The outside turning tool is shown in Fig. 18, the nature of which has already been referred to. For accurate reaming it is advisable to hold the reamer in a floating holder. If necessary to tap the head the inside turning and reaming may be omitted and a tap substituted.

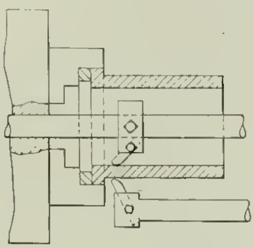


Fig. 19

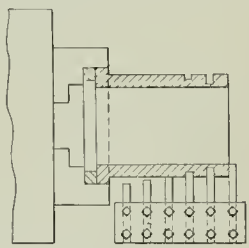


Fig. 20

Turning Air Pump Piston Packing Rings

The regular cams supplied with the machine may be used for the turret. The cams for the cross slide would have to be set to insure that the cross facing does not interfere with the turret tools, which is a comparatively simple operation. The time for making this piece would be less than is required to make it on a center lathe on account of the tools being set to size on this machine and requiring considerable resetting and adjusting when made on a center lathe. Considering the fact that one operator may attend to three or four of these machines, their economy is self-evident.

Air pump piston packing rings may readily be made on these machines. The general custom is to make the castings in pots which are held in the three-jaw or a special chuck and about the same practice is followed as in chucking cylinder packing. When machining, the outside and inside of the pot is turned at one time by tools held in a fixture secured to the turret face and provided with a pilot bar passing through a bushing in the chuck for the purpose of steadying the fixture. The outside is then finished with a second similar tool, also guided with the pilot bar as shown in Fig. 19. The rings are then cut apart by a number of cutting off tools, as shown in Fig. 20. This method is followed very largely by automobile manufacturers.

Globe valve parts may also readily be finished on this class of machine, the tooling operations not differing materially from turret lathe practice, except that the self-opening die,—generally hand-closed,—should be used. A valve bonnet will be used as an illustration, shown in Fig. 21. This piece may be held in a three jaw chuck if such device is suitable, or if of a special shape, special jaws that conform to the shape of the bonnet may be necessary. The first operation would be to turn at one time the outside of the shoulder, the threaded portion and the end, with the tool held in the tool holder supported from the turret. At the same time the hole would be drilled and countersunk by a combination drill and countersink held in the same tool holder. After this operation is completed the piece would be necked and the shoulder rounded over by tools held in the front cross slide. The hole would then be finish reamed by a reamer held in the floating tool holder and the countersunk seat may be finished by combining the reamer and countersink. After this the piece would be threaded. Should this piece require

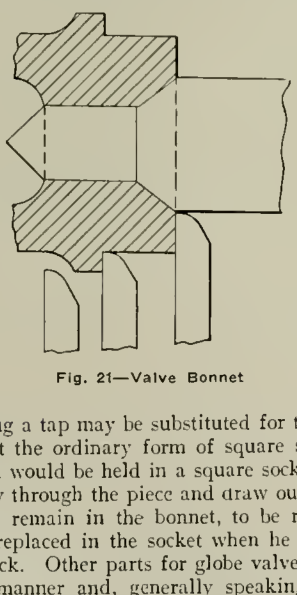


Fig. 21—Valve Bonnet

inside threading a tap may be substituted for the last reamer, in which event the ordinary form of square shank tap may be used, which would be held in a square socket and allowed to feed entirely through the piece and draw out of the socket; the tap would remain in the bonnet, to be removed by the operator and replaced in the socket when he takes the piece out of the chuck. Other parts for globe valves may be made in a similar manner and, generally speaking, require only such special tools as would be needed on a turret lathe.

MANAGEMENT OF AUTOMATIC MACHINES

There is some diffeience of opinion as to the speeds and feeds at which automatic screw machines should be operated. Fast cutting speeds and feeds naturally turn out more work per minute. To offset this the cutting tools dull more rapidly which makes it necessary to stop the machines for the purpose of sharpening the tools. Slower speed results in smaller output per minute, but also in less delay. Generally speaking, for soft steel where good, high speed steel cutting tools are used and also a good grade of cutting oil, a cutting speed of 100 ft. per minute and a feed of 1/200 to 1/50 in. per revolution can be maintained without too frequent sharpening of cutting tools. By observing the speeds on a few jobs made from various grades of material, a fair estimate may be made as to speeds for new jobs and data secured for selecting cams and setting spindle speeds. These machines are equipped with oil pumps for flooding the tools with cutting oil, and may therefore be used at top cutting speeds.

SUPERVISION

In most shops where automatics are installed it is the custom to assign one man to these machines, whose duty is to see that they are properly set up, and in case there are only a few machines, to do the actual setting up and also to make a study of various contemplated jobs to ascertain if they can be made on these classes of machines to advantage. Such a man will soon find a number of jobs that may be made cheaper on the automatics than by other methods, resulting in reduced shop costs. This supervisor should make sketches of the first set-up of various jobs on the various machines. These will be of assistance for future jobs. Preferably a draftsman should make drawings of the set-ups, which will be valuable as shop records and also in the absence of the supervisor. This will work two ways. If the machines are not run up to the original speed some one is at fault. If the supervisor is ambitious he will soon find ways to turn out work quicker than the original set-up.

The nature of the work will govern the number of machines per man. Generally speaking, one operator is necessary for four machines.

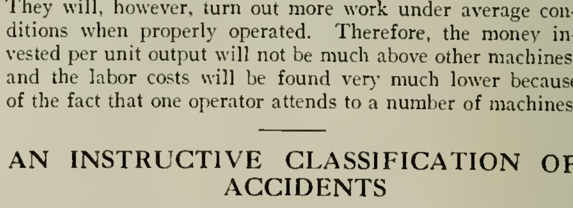
WHEN SHOULD AUTOMATICS BE INSTALLED?

There is not much to be gained by installing less than four automatics. This number would require one man to supervise and set up and one man to operate. The machines need not all be the same, but should be selected with reference to the work that is in sight. Under most conditions for railway work one multi-spindle machine for staybolt sleeves, having bar capacity of about 2¼ in., two single spindle machines of about 2¼-in. bar capacity and an automatic chucking machine will be found suitable. These will demonstrate the possibilities of this class of machine.

Considering these machines from an investment standpoint, they generally cost more than plain machines of equal capacity, such as lathes, turret lathes or hand screw machines. They will, however, turn out more work under average conditions when properly operated. Therefore, the money invested per unit output will not be much above other machines, and the labor costs will be found very much lower because of the fact that one operator attends to a number of machines.

AN INSTRUCTIVE CLASSIFICATION OF ACCIDENTS

The Pullman Car Works recently analyzed the accidents occurring in the company's shops during the year 1918 to determine the relative extent to which the various parts of the body were involved. The result of this analysis is shown



Anatomical Distribution of Accidents

in the chart below, which is taken from the Pullman Car Works Standard. It is interesting to note the large percentage of optical accidents, many of which were due solely to the carelessness of employees, as they could have been prevented by the wearing of goggles, which are furnished free of charge.

Who Are the Real "Live Wires?"

"J. W." Discovered One of Them Just in Time; Read the Story and Then Formulate Your Own Answer

BY A. J. TEN CATE

THINGS were not breaking right at Hadley. Everybody knew that from the office boy who shot craps in the filing room with Rastus Johnson, the colored janitor, to the president of the road 500 miles away, it was known that something was amiss, that something was radically wrong in the big shops at Hadley. Not that there was friction of any kind to mar the harmony of the organization; there was no factional strife—no pulling against one another, nor was there any lack of loyalty on the part of the organization to the shop superintendent, John Williams, commonly known among the men as J. W., whom the men all respected, and who in turn swore by his men.

True he swore at them as well. In fact he hadn't done much of anything else lately but express his feelings in profanity of the sulphuric sort, for to tell the truth, J. W. had seen matters go so rapidly from bad to worse during the past few months that he was beginning to feel that he had a "Jinx" of some kind hovering over his head that was destined to "get him" if things didn't change mighty soon at

Even the Office Boy, Who Shot Craps in the Filing Room with the Colored Janitor, Knew that Something was Amiss

Hadley. But deep down in his heart he had always believed in his "boys" as he called them—had faith in their ability and loyalty and, up to the time our story opens, he had felt that they would be able to overcome the difficulties looming up so formidably and soon have things going right.

With but few exceptions, the personnel was the same as it was six years before when J. W. took charge. He had come to Hadley at a particularly opportune time, succeeding a man who had been very unpopular with the organization and, having had a large experience in handling men he had shrewdly "cashed in" on his predecessor's unpopularity by showing an immediate disposition to treat the men fairly. By quickly gaining their confidence and good will, he had soon secured a spirit of co-operation heretofore unknown. Of course, this had a decidedly beneficial effect on shop output and better results than ever before were soon obtained at Hadley and J. W. was given the credit for being a genius in shop management, without having really effected a single change in the organization or methods. The output prior to his advent had been 12 to 14 engines a month, which soon increased to 16, a figure never before reached in those shops.

Naturally, the management was highly pleased at the showing and the superintendent of motive power never lost an opportunity of telling how they did things at Hadley.

The shops at Hadley had always taken care of the general repairs on all power operating on three principal divisions. This had been done satisfactorily for many years, but gradually, as traffic grew, and new and heavier power was made necessary, it became increasingly evident that Hadley shops were entirely inadequate to handle the repairs required to keep power in shape. In fact, scores of engines had been put in service that could not be gotten into the shop at all. For a while these engines were given only light repairs in the various round houses where they were assigned, but this of course, could not continue, and with a greater volume of business than ever confronting the road, the company had finally decided to enlarge Hadley shops to suitable size and capacity for the overhauling of 30 engines per month. The work had been started a year and a half before the commencement of our story.

BUILD NEW SHOPS AT HADLEY

Unlike many roads where large shops are reconstructed, there had been no controversy of any kind over proposed design or construction. When it had finally been decided to make the improvements, "Get together" meetings were held, often in the president's office and everybody who had an idea was given an opportunity to express it. When the final plans had been approved it was found that the cost would approximate a million dollars, but this was not considered too great an expenditure for the results expected.

When it came to shop equipment, machine tools and appliances, the management had used a lavish hand, installing many of the new and expensive tools which, to J. W., seemed unnecessary and ill advised. In his estimation, the majority of the later types, which were unknown in his day, were only useful on special work, and he would much rather have had more lathes, planers and boring mills than the grinders, millers of various types and other machines which were not familiar to him. He seriously doubted their ability to make good on general utility work.

When the shops were completed and everything in readiness for operation, it was conceded by those who were in a position to compare them with other shops of similar capacity, that the new shops were far superior in many ways and capable of greater output than many shops of a more pretentious character employing a greater number of men.

"J. W." COULDN'T GET 30 ENGINES A MONTH

The first month or two after completion nothing was said to J. W. about output. That it would take some little time to get organized on the new basis was to be expected, and as he enjoyed the confidence of the management to an exceptional degree, nothing was said when at the end of two months the output had only been increased to 19 engines per month. But now after six months, and with 20 engines, the largest number overhauled so far for one month since the shops had been completed, the management had begun to take serious notice of the unfortunate situation. At first, only inquiries of the most friendly character had been made. These failing to bring satisfactory explanation for past failures, and to convey information as to when an improvement could be expected, soon became demands for explanations.

The situation was greatly aggravated by the division superintendents, who were constantly wiring the general superintendent about congestion in their respective territories due to shortage of power on account of inability to get engines through Hadley shops. The president, who had been extremely lenient the first few months, was now aroused over the situation and demanded results without delay.

Of course the superintendent of motive power was after J. W. and J. W. was after everybody at Hadley.

A mechanic of the old school and still clinging to many old fashioned ideas, he made no effort to solve the problem by applying new methods. In fact it was known that J. W. had but little time for some of the new fangled notions advocated in other shops. He had held staff meeting after staff meeting during this period and given everybody a chance to make suggestions for improvement. But no one came forward with anything tangible in the way of a solution. None of them had ever been employed in a supervising capacity elsewhere and only knew one way to handle their work, and that way was not getting results now.

At these meetings it was invariably brought out that the machine shop was inadequate to turn out the finished parts for an output of thirty engines per month. To do the machine work for this number of engines, and at the same time fill the many shop orders to keep six round houses supplied with finished material ready to use, was altogether too much for the machines they had. Fred Shipley, the machine shop foreman, whose ability was unquestioned, said it could not be done. George Wheeler, the general forman, was equally sure that Fred was right.

The erecting foreman agreed to put the work up and get the 30 engines, if he could only get the finished parts as fast as he called for them. J. W. got acrimonious as time went on and the demand of the management for output became more insistent.

"SOMEBODY HAS GOT TO DO SOME HEAVY BATTING"

One day he received a message from the president to meet him at the station on arrival of Number Seven. He was under no illusions whatever as to the character of his forthcoming interview with the big boss, and as he climbed on board the president's car that afternoon, and noted the expression on the face of the president who had always before had a smile of welcome for him, what little hope he had failed him. He realized that something *would* have to be done if he remained at Hadley in his present position.

"Mr. Williams," said the president, when J. W. was seated, "if I had lost that million the company gave me for improvements here in a good clean cut, fast game of poker, I would not have felt so bad about it as I do under the present circumstances. As the game now stands"—the president was an old baseball fan—"the company has put up their good money for a fluke—not a hit made so far. I wanted to say to you first hand, so there wouldn't be any misunderstanding about the matter, *somebody in Hadley has got to do some heavy batting from now on.*"

When he got back to the office, J. W. sat down and thought the matter over. It was plainly apparent that he was getting all he could out of his organization under present methods. While he seriously questioned if the results expected by the management could ever be obtained, he began for the first time to consider a change in foremen.

As this idea became fixed in his mind, he left his office and started down through the shop. At every machine he passed he noticed the inevitable pile of work waiting its turn to be finished, all marked "rush." He noted that every operator was pushing his machine, both feed and speed.

"I doubt if it can be done," he said to himself as he reached the lower end of the shop. As he turned round he was attracted to a big boring mill over at his right which was being operated by a tall, broad shouldered young man of perhaps 25 years of age. J. W. instantly noticed piles of finished cylinder packing rings close at hand, and a little further away some pistons which were completed. It was the only machine he had seen so far that did not have a lot of unfinished work piled all around. He remembered too, that this was always the case with Tom Wilson's machine, and he wondered why he had never looked into it before.

"J. W." HEARS THE TRUTH

With this thought in mind he walked over near the machine and watched its operation awhile. Suddenly it struck

"If I had lost that million the company gave me for improvements here, in a good, fast game of poker, I would not have felt so bad about it as I do now."

him that for a boring mill, running as that one was, it was unusually silent. Most mills he had ever run were about the noisiest machines in the shop, especially when going at the rate this one was running. The next thing that attracted his attention was a tool the operator was using that was doing business very effectively. J. W. was interested.

"Tom," he finally said, "you certainly have the edge on the rest of the gang when it comes to turning out work. You're the only man in the shop who is not snowed under; how do you account for it? "Why, I guess there ain't any secret about it, Mr. Williams," replied Tom, as he looked around with a smile, "I simply try to use my head and spare my heels; anybody can do the same if they try."

"Some tool you have there, Tom," went on J. W. eyeing it, "where did you get hold of that? I never saw one like it before."

"Why, I got the idea from something I read, got the blacksmith foreman to make it for me and you see the result; she sure does the business;" replied Tom proudly. "Saves tool steel too," he went on, "don't use half so much as I used to since I got hold of this tool."

"How do you keep that mill so quiet?" J. W. asked, as he again noticed how still the boring mill was running.

Tom laughed. "Well sir, I thought you'd notice it after awhile. I just experimented on a little compound of my own. I read awhile ago of something that was done like that somewhere else and I just thought if I could produce a little silence instead of listening to the constant noise this machine always made, it would be a welcome change, so I went at it and you see what it does. I only use it twice a week; costs less than the old way of oiling and the comfort I have had since I began to use it can hardly be described.

Tom's replies set J. W. to thinking. He knew Tom Wilson was an energetic, observing fellow. He knew too, that he had never heard a complaint from any one about pistons or cylinder packing since Tom had been put on the job, and before that, it was nothing but complaints. Tom's evident resourcefulness prompted J. W. to sound him a little on the subject nearest his heart.

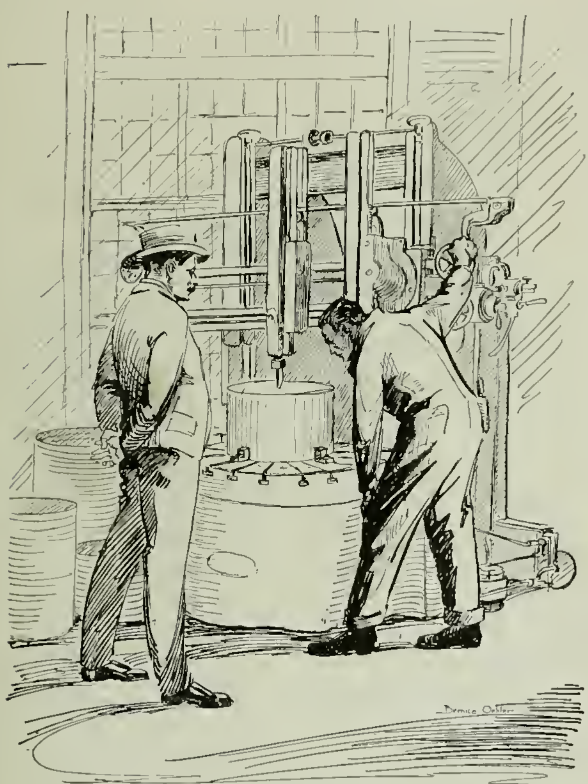
"I wish I could get the same results from other machines that I get from yours, Tom," he said. "You know we are trying to get 30 engines a month; what do you think of it?"

"Well sir," replied Tom, "I can't see why we shouldn't."

"You can't!" gasped J. W., scarcely believing he had heard Tom correctly.

"No sir," asserted Tom, "I can't see why."

"You're crazy," said J. W. when he had regained his speech. "Do you see anybody idle up through there?" pointing at the long lines of machines and their operators, all hard at work.



J. W. Walked Over Near the Machine and Watched Its Operation

Tom merely glanced in the direction indicated and said quietly, "It is not a question of anyone being idle, Mr. Williams, it is only a matter of method."

"What do you mean by that?" demanded J. W., his gorge rising at the cock-sure manner of treating a matter which had caused him more sleepless nights than anything else he could remember ever having been up against. "Do you know any better methods?"

He never did relish criticism and when it came from a man like this, only out of his time about three years—well, it didn't listen good.

"I know this," said Tom, noting his chief's rising anger, "there are many machines in this shop not operating half the time, that are considered big producers in other shops. Those grinding machines, for instance, only do certain work here, while in other shops where they've got them, they work night and day on work never attempted on them here.

"They are grinding driving and trailer axles, engine truck journals and packing rings in many shops now-a-days, and doing it quicker, more accurate and with a better finish than by the old way. There are other machines here too," went on Tom, "that are handled to better advantage elsewhere, which could help relieve the congestion here."

In spite of his anger, J. W. felt he was hearing something worth while from a man he knew to be no fool. Determined to get all he could out of Tom, he went on.

"How do you happen to know so much about what they do elsewhere, that's what I would like to know?"

"Well, sir," replied Tom, "for one thing I read. I like to keep posted on my line of business. You probably see more of the mechanical papers than I do."

"Oh yes," replied J. W., "I see enough of them, but you don't suppose I spend my time reading all the stuff they print, do you? Theory is one thing, my boy—practice is another." J. W. prided himself on being practical.

"But they are not all theory, Mr. Williams," said Tom. "For instance, a few months back I read an article on how they did their driving boxes at Sawyer on the R. L. & N. Jack Raymond is working in Sawyer. You remember Jack—worked here while I was serving my time. Well, I wrote and asked him if they were actually doing it the way the article said? He replied that they sure was."

J. W. was silent. He felt he had heard the truth, but it had come in painful doses for ready assimilation. He turned without a word and started away.

Suddenly he wheeled around to Tom again and said, "Why the devil didn't you speak to Shipley about all of this long ago?"

Tom tried to evade the question but J. W., his suspicions now aroused, insisted on a reply.

"Why, I did a couple of times, Mr. Williams," he said, "but he didn't take very kindly to it."

"What did he say?" demanded J. W. "I want to know."

"He told me I was hired to run a boring mill, that he could do all the theorizing that was necessary around here."

"He did, eh?" said the irate shop superintendent, now fully understanding Shipley's attitude at a time when he ought to have welcomed a suggestion from anybody interested enough to make one. "You shut down your machine and come to the office with me."

A NEW MACHINE SHOP FOREMAN AT HADLEY

On the way J. W. met the call boy and sent him for the general foreman and Shipley, who soon appeared at the office.

"Gentlemen," began J. W. as they were all seated, "it has come to a point where things have got to be done different around here. We've got to get out more machine work if we increase our output to thirty engines. What are you going to do about it, Shipley?"

"I have done my best," replied Fred, "and I am ready to take my hat off to the man who can get out any more work than I have already done. I can't get blood out of a stone and neither can anyone else, but I'd much rather go back on a machine and let someone else have the job for awhile, than to stand the gaff for not being able to meet somebody's unreasonable expectations; I've had all of that I want."

"Well, Fred," said J. W. after a pause, "I am going to take you at your word. Take any machine you want in the shop, and Mr. Wilson here," looking at Tom, "will take your place tomorrow morning. What do you say, Tom?"

"I'll do the best I can, Mr. Williams," said Tom, "but I would like to have you make it clear to these gentlemen that this is entirely unsolicited on my part, and something I never dreamed of."

"What he says is exactly right," said J. W., turning to Shipley and the general foreman, "I never thought of this change myself up to twenty minutes ago. I want it understood that Tom had no knowledge of this move or reason to believe he would ever be considered for the place. Further, if he don't make good he will come off the job just as suddenly as he goes on," and with this parting comment the meeting closed.

The next morning Tom took charge. The first thing he did was to get some men on the machines not regularly run, with instructions to clean them up, inspect and oil them ready for business. He then began a thorough check on work most needed by the erecting side and gave this immediate attention. Inside of a week he had re-distributed the work that was piled around the machines with the result, that in an incredibly short time machine production of required work began to increase. The grinders were kept going constantly on work formerly done on lathes, and the milling machines began to make a little money for the company, as Tom put it. In short, every machine was allotted only the work best suited to it, and each was worked to capacity.

THE SHOE BEGINS TO PINCH THE OTHER FOOT

Along with the new order of things there came a better spirit of co-operation on the machine side. Long blamed for holding up output, constantly rushed from one job to another, weeks of work always ahead of them, and never permitted a day off, no matter how hard they worked—many of the men had long since lost interest in their work and some of them had sought more congenial conditions elsewhere. After Tom Wilson had been in charge but a few days all that was changed. The big piles of waiting work had somehow disappeared. The men soon noticed too, that they were not being nagged by erecting foremen after this or that piece of work. Those gentlemen, formerly on the machine side half the time finding fault about delayed parts, suddenly seemed to have more business on the erecting side to engross their attention. The erecting gangs were having all they could do to put up the work Tom was sending over to them.

J. W. was not slow to notice the welcome change. The way he went after those foremen and the general foreman "was good for sore eyes," as old Sam Mason said. Sam, one of Tom's lathe hands, had overheard some scorching comments J. W. had made to the general foreman about "the shoe pinching the other foot now."

Tom kept after the machine work and his men were with him, for they liked the results of his new methods. They hugely enjoyed the turn affairs had taken; it was a satisfaction to see some one else the goat.

In the meantime it had become apparent that, while output for the month would reach 25 engines, the erecting side could handle no more than that. Much of the machine work for other engines laying in the shop had been done but no effort had been made to start putting it up.

"Tom," said J. W. one day, "we've got 'em going; we are going to get 25 this month. I only wish I could get another one or two."

"Why I guess we can do it, Mr. Williams," said Tom after thinking a moment.

"How can we do it, Tom?" demanded J. W.

"Why I am way ahead of the game and happen just now to have a man who says he is an old erecting foreman and I can spare him for awhile. He told me this morning that he would like to show them how to put one together, and I could give him another good man, a couple of apprentices and some helpers. I'll gamble they would get a couple more; the work is all ready for hanging, you know."

"All right," said J. W., "get those fellows lined up and see whether you can get the engines out."

That afternoon the new gang went to work. Whenever Tom could send them any more help he did it and two more locomotives were added to the month's output. The general foreman was not at all pleased with this arrangement and frequently let Tom know it.

When the end of the month arrived 27 engines had been overhauled. J. W. was jubilant. He openly gave Tom credit for all that had been accomplished and this was more than the general foreman could stand. He went to J. W. and requested a leave of absence, he was "all in" he said and needed a rest.

TOM'S METHODS GET RESULTS

J. W. told him to take as long a vacation as he wanted, secretly delighted at the turn events had taken, for he knew

"I Like to Keep Posted on My Line of Business"

Tom could do better with the general foreman's influence out of the shop. He gave Tom full charge temporarily.

Tom's first official act was to mark up 30 engines for the next month's output. His next was to divide up the erecting gangs so that more engines were covered at one time. With the general foreman gone, Tom had no difficulty in securing the best of support from everybody. By the middle of the month it was clear the 30 engines would come easy and the entire organization was as proud of the showing as J. W., who was beginning to enjoy life again.

One day toward the end of that month he sent for Tom and showed him a letter of resignation he had just received from the general foreman, who had secured another position.

"Tom," said J. W. after he had read the letter, "I'm going to appoint you to the position. The superintendent of motive power is mighty well pleased with what we are doing here now, and I want to see the same results continue."

"Thanks, Mr. Williams," Tom said, "I'll do my best."

A day or two later J. W. was down at the depot just as Number Seven pulled out. As he glanced down the long train he noticed the private car of the president on the end.

"Wonder what he thinks of our batting average now?" he mused.

With his eye following the rapidly moving car, he paused at the end of the station platform. As the car was passing him, the president, who was seated at a window, saw J. W. and started for the door.

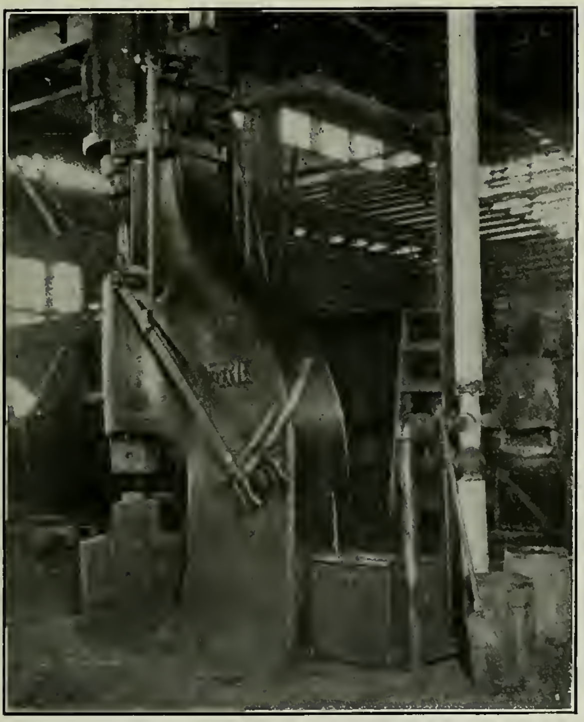
From the rear platform he called out "How's the game?"

Putting his hands to his mouth, megaphone fashion, J. W. roared back, "*Everybody batting over 300.*"

New York Central Steel Car Shop

Well-Equipped Plant at Ashtabula, Which Employs Some Unusual Methods of Forming Parts

THE INCREASE in the amount of steel car work at Ashtabula, Ohio, several years ago overtaxed the capacity of the existing facilities. To take care of this class of work a special shop was erected in 1914 on a site about one mile west of the old shops. This building is of brick, concrete and steel construction, 431 ft. 3 in. long and 243 ft. 6 in. wide. It is divided into three bays of approximately equal width. The roof has six square double monitors, 10 ft. high extending across the building, the extreme height at the gables being 51 ft. and at the sides 42 ft. Each of the two side bays has four tracks with a capacity of eight cars each, on which the repair work is done, and two standard gage material tracks. The repair tracks are spaced 18 ft. apart, except where the supply tracks run between them, in which case the distance is increased to 22 ft.



Steam Hammer Operated by Either Steam or Air

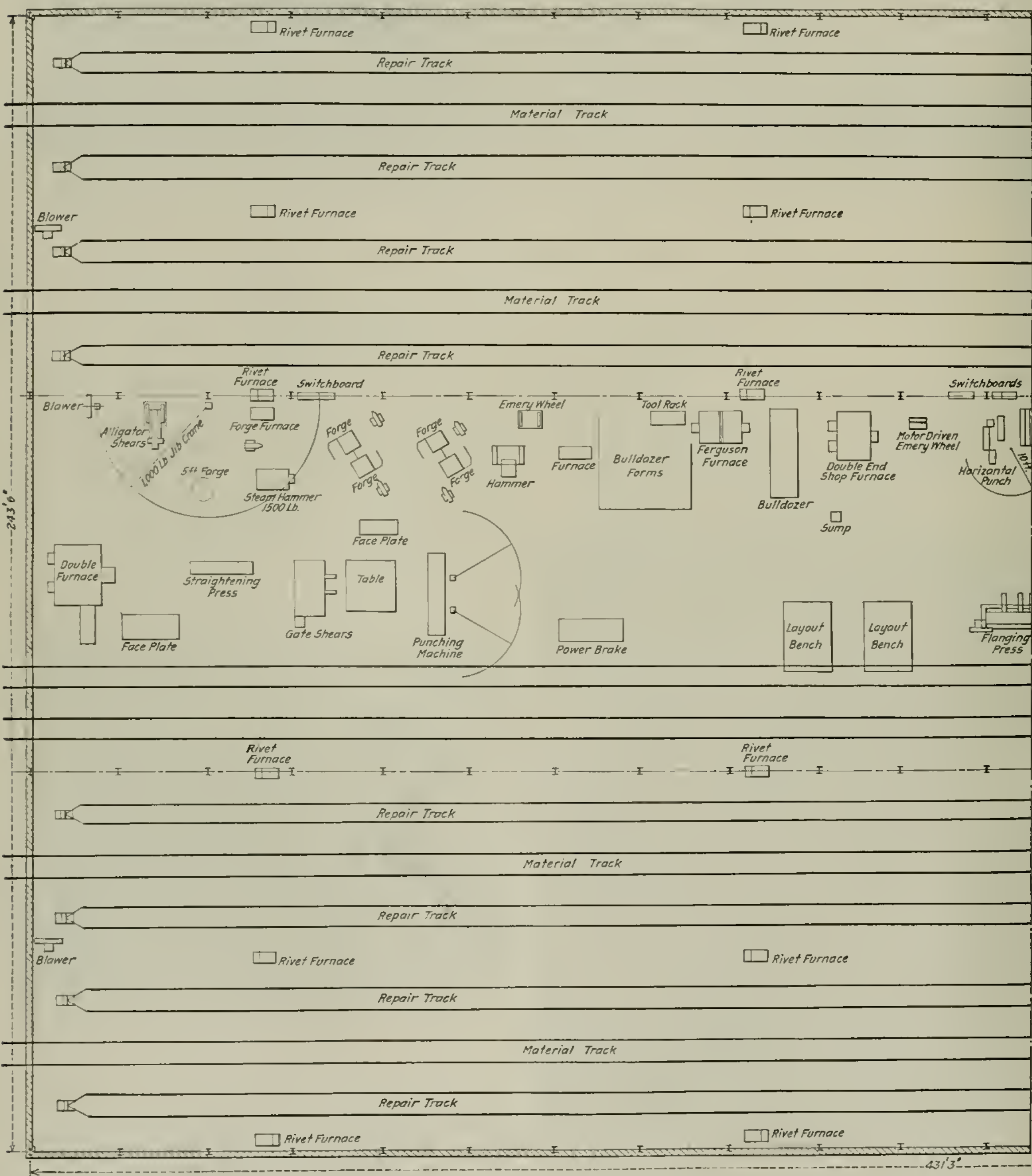
The center bay is used for straightening, fabricating and machining, all the machine tools being located in this section. A supply track extends along the east side of this bay for its entire length and a short stub track runs in at the north end. East of the main shop building are the office, store room, power house and transformer building and the air brake building.

Power for the shops is secured from a high tension power line at 13,000 volts and is transformed to 440 volts for power and 110 volts for lighting. The shops are heated from a battery of three locomotive boilers, two of 150-hp. and one of 100-hp. capacity. A vacuum return system is used, the radiating pipes being placed directly on the walls and columns. The compressed air is furnished by two Ingersoll-Rand electrically driven compressors, each having a capacity of 1,500 cu. ft. per minute. Air lines are installed along both sides and also between the center tracks in each working bay. Fuel oil is piped from the storage tanks, located adjacent to the store-house, to the plate furnaces in the center bay and to the stationary rivet furnaces located in the side bays. All the furnaces are also supplied with natural gas, which can be used in case of a shortage of fuel oil. Air for the blast is furnished by electrically driven blowers, one located in

Parts Formed on the Bulldozer

each bay. The lighting system consists of incandescent lamps in enameled steel reflectors set along the bottom of the roof trusses with connection for extension cords along the walls.

The main shop building has traveling cranes covering



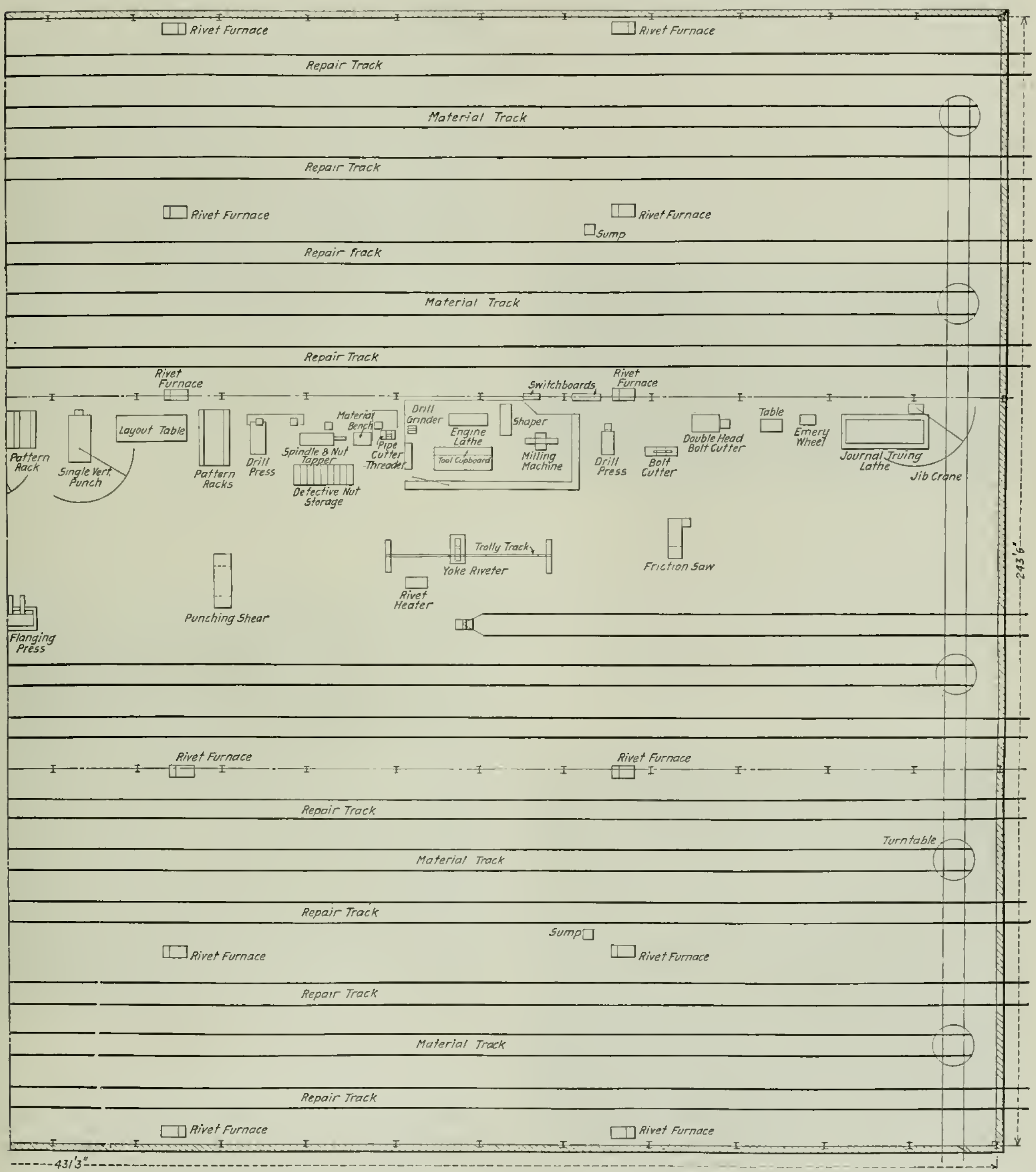
South Half of the Ashtabula Steel Car Shop

the entire floor area of all three bays. The cranes are of 20 tons capacity and run on rails 24 ft. above the floor. Further facilities for transporting material are furnished by the supply tracks which run between the repair tracks and extend on to the material platform at the south end of the shop. There are two traverse tracks crossing all the supply tracks, one on the material platform, and the other just inside the north end of the shop. Turntables are provided at the intersections of the tracks.

The track layout is such that cars enter and leave the repair tracks from the north end of the shop only. When the cars are set in the shop they are lifted by the crane while the trucks are removed and horses set under the body. The trucks ordinarily remain on the track at the end of the car while it is being overhauled, except that when wheels are to be changed or other similar work is to be done, the trucks are often set in the supply track. The forces working on dismantling and assembling are divided into gangs of six men each, three usually working on each end of a car.

The majority of the work of straightening sheet metal parts is handled at the extreme south end of the shop, where there is a double furnace 10 ft. by 12 ft. 8 in. Adjacent to this is a large face plate and a pneumatic straightening press. A large jacking stall is now being erected outside the shop to care for cars on which the parts can be straightened without being removed. Next in order along the center bay is the blacksmith department, which has five forges and anvils and two power hammers.

The heavier work in the blacksmith shop is handled on a 1,500-lb. Erie steam hammer, while for lighter operations a Bradley impact hammer is provided. A notable feature in connection with the steam hammer is the fact that it has both steam and air connections. This hammer is the only steam driven tool in the plant and it would have been necessary to keep one boiler in service at all times in order to operate it,



North Half of the Ashtabula Steel Car Shop had it not been possible to use air pressure in the summer.

A large amount of the forming work done at this shop is pressed out in a No. 8 Ajax bulldozer driven by a 20-hp. motor. Dies have been made at this shop for many of the standard sheets used in all types of steel cars owned by the New York Central Lines. These dies are of unusual construction, being built up of plates and bars riveted to the plates which form the base. While this type of die was adopted largely because it could be more readily made with the facilities available, it has numerous advantages over cast iron dies. It can be made without a pattern, it will not break and errors in machining can usually be corrected at slight expense by changing a few parts. Two of the illustrations show a typical pair of dies, together with the part which is

Built Up Dies Used on the Bulldozer

formed on them. Another illustration shows the wide range of work that is handled on the bulldozer. The parts include hopper side sheets, hopper doors, side stakes, carrier irons, striking plates and end sill corner braces. The bulldozer is also used for the class of work generally performed on these machines, such as forming coupler yokes, etc.

Alongside the blacksmith department are located some of the machines for the cold working of plates. These include a Hilles & Jones gate shear 124 in. between the housings with a 20-in. throat, having a capacity for cutting 5/8-in.

Power Brake With Capacity for Bending Half-Inch Plates, Twelve Feet Long

material, and a Cleveland vertical, double ended punch and shear with a 48-in. throat. Cold flanging is handled on a Chicago power brake with a 12-ft. by 6-ft. table. This machine is driven by a 25-hp. motor and will bend a 1/2-in. plate 12 ft. 1 in. long. When working on parts made in quantities it can be set to bend any desired angle, which will be automatically duplicated until the machine is reset. For other flanging work there is a 200-ton hydraulic press built in the railroad company's shops.

Two large layout benches are provided near the flanging

Built Up Bulldozer Dies and Hopper Side Sheet Formed by Them

press. The laying out on the majority of plates for system cars is done with templets made of sheet metal. Wooden templets are often used on work of this nature because of the ease with which they can be made. The use of wooden templets was not considered advisable at this shop because of the excessive amount of space required for the storage of a large number of templets and also on account of the possibility of inaccuracies due to warping and shrinking. The metal templets are cut away wherever possible in order to decrease the weight. In this form they are easy to handle and experience indicates that, due to their longer life, they are

Sheet Metal Templets for Laying Out Parts of Steel Cars

more economical than templets made of wood, even though the first cost is higher.

For punching partly or wholly completed sheets a horizontal and a vertical punch are provided near the center of the shop. Large plates and angles are handled on an Oeking combination punch and shear, which will split plates of any length and width and will shear angles up to 3/4 in. by 6 in. by 6 in. and bars up to 2 1/8 in. square. Large structural steel shapes are cut on a Ryerson No. 2 friction saw with a capacity for cutting 15-in. I-beams, up to 60 lb. per ft.

Parts which can be assembled before erection are handled with a Hanna pneumatic riveter especially arranged for this work. The machine which has a 20-in. gap and a 24-in.

throat is mounted upright on a stake. A chain hoist runs on a trolley track directly above the riveter so that parts after being assembled can be slung from the hoist to facilitate the riveting operation.

The tool room is located in the north end of the shop. It provides a supply of pneumatic and hand tools and makes the special appliances used around the shops. The machine tool equipment consists of a 24-in. heavy duty shaper, a Lodge & Shipley 8-in. engine lathe and a Kearney & Trecker No. 2-B Universal milling machine. Beside the tool is located equipment for reclaiming miscellaneous small material. The small scrap collected around the shop amounts to about 20 tons a month. From this material the bolts that

Machine Used for Truing Journals by Grinding

are fit for rethreading and nuts that can be retapped are sorted out and returned to the shop where they are reclaimed and again placed in stock.

The truing of cut journals is handled at this shop on a special machine built in the railroad company's shops, on which the journals are ground instead of turned. The illustration shows the general arrangement of this machine. The wheels and axles are swung on centers and are driven by a dog attached to one journal. At the other end of the machine there is a tool post which carries a grinding wheel driven by a belt from an overhead countershaft. The wheel can be traversed back and forth along the journal until it is ground truly cylindrical. Because of the fact that no water is used while grinding the journal is polished by the use of emery paper. This device makes it possible to true journals with the minimum reduction in diameter. It is being installed at all the principal car repair shops on the New York Central Lines.

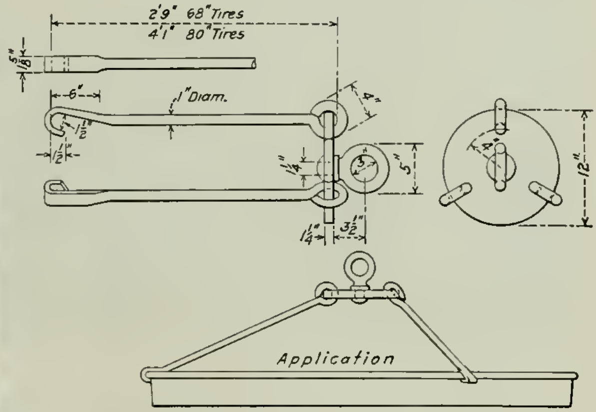
TIRE LIFTING DEVICES

BY E. A. M.

Crane attachments for lifting plain and flanged locomotive tires as illustrated in the drawings have proved very useful.

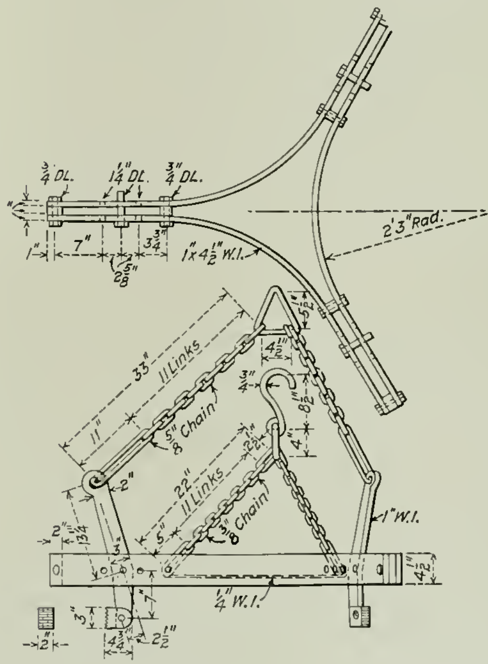
The device for lifting plain tires is made of three pieces of 1-in. by 4½-in. wrought iron bar bent to a radius of 2 ft. 3-in. and bolted together by ¾-in. bolts, as shown in the drawing, with a spacing block between the bars to provide space for a lever near each of the three ends. These levers are of 1-in. wrought iron, three inches wide at the center, where the pin is inserted, and two inches wide at the ends. On the lower end of each level a steel jaw with teeth cut in it engages the tire while lifting it, the weight of the tire tending to tighten the grip of the jaws. On the upper end of each lever is a link and a ⅝-in. chain connecting the levers to a triangular link in which the crane hook is inserted. Three holes in each arm of the device, where the levers can be placed and the pins inserted, provide a means of adjustment to accommodate tires of different diameters. The small ⅜-in. chain is only for the purpose of carrying the device from place to place as it may be needed, the ⅝-in. chain being used for lifting.

The other device for lifting flanged tires consists of a plate 1¼ in. thick and 12 in. in diameter with three 1 1/16-



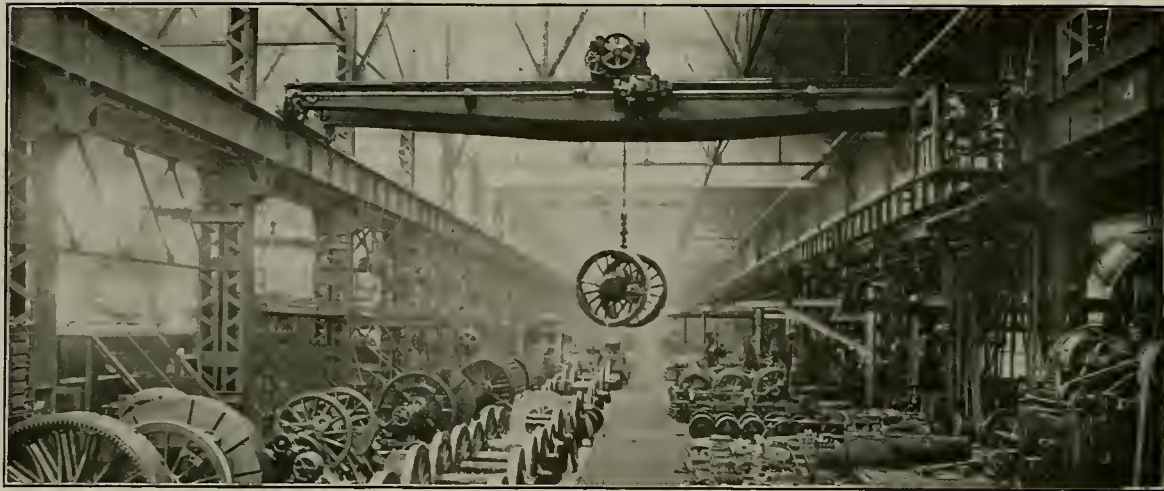
Lifting Device for Flanged Tires

in. holes drilled in a 8-in. circle and a 1-in. diameter rod with a hook on the lower end placed through each of the three holes with the eye bent over as shown in the drawing. An eyebolt of 1-in. round material is inserted through a hole in the center of the plate and riveted over on the under side, thus providing an attachment to the crane hook. The



Lifting Device for Plain Tires

three rods which engage the flange of the tire may be made in any desired length to accommodate a number of different sizes. By making the various parts to a close and accurate fit the hooks cannot slide and provide a safe method of handling locomotive tires.



C. P. R. Machine Shop, Angus (Montreal).

C. P. R. Shop Production Methods

Schedule and Follow-Up System which Is Part of, Not Separate From, the Producing Organization

BY E. T. SPIDY
Production Engineer, Canadian Pacific, Montreal, Quebec

PRODUCTION methods are the ways and means by which we get output whether it be locomotive repairs or new locomotives, coach repairs or new coaches, freight cars or anything else that constitutes a manufactured product.

Two methods which have generally been used with more or less success, according to the manner in which they have been employed, may be enumerated as controlling factors in getting a satisfactory output. The first and oldest is to have a piecework or other system that provides an incentive to the operator by making his earnings dependent on the amount of work done. The second, which may be said to be of latei origin, is to lay out for each plant, shop, department and, if necessary, each workman, its day's work and to make possible the accomplishment of the task assigned by routing the work, tooling the shop machinery and taking measures to overcome all the factors that militate against the desired end.

The developments of the last few months with regard to piecework have created in most railway shops a condition which throws the onus of production entirely upon the management. If the managements do not have any other means or aid to maintain output than the regular supervision, then undoubtedly they are going to be hard put to it to maintain anything like their previous records.

Leaving the dead alone, however, the writer will confine himself in this article to the second class of aids to production, i. e., the setting of the day's work for each department and the means whereby each item may be followed up and completed on time, at the same time not interfering with the foreman's authority in each section.

The fact that the foreman's authority need not be interfered with is mentioned purposely. There are shop managers who will say that "we found it impracticable to run a schedule and have thrown it out long ago." No doubt this has been done and the reason is obvious enough when looked for. With these shops, the writer will willingly agree that it is impracticable to put into the hands of a set of clerks the running of an absolute schedule and to expect them to get results. *It is absolutely impracticable to get any results from any system unless all the foremen are convinced that the principle behind it is right and that they themselves, each in his own department, are the men who are running it and backing it.*

This all may be summarized by saying that co-operative

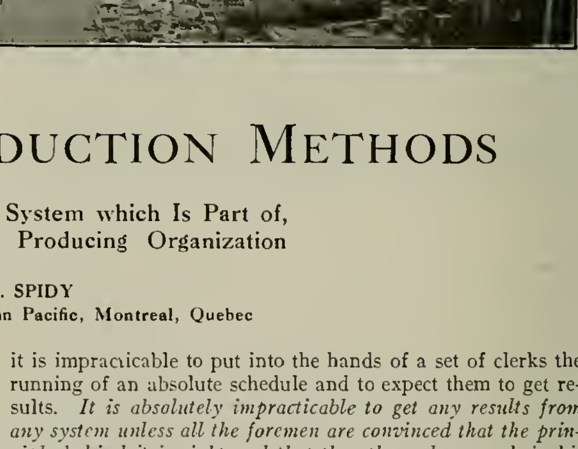


Fig. 1—How the Production Department Ties Into the Shop Organization

effort is necessary. Now the principle that actuates a successful production, planning or schedule department is just this: The production department is simply a specialized group of men who, at the direction of the management, spread over the month at as regular intervals as practicable the output as required by road conditions so that each departmental foreman receives each week or day one sheet which tells him exactly *what* he is required to deliver finished and *when* the delivery is required. It is obvious that such a group under proper direction must have more information regarding delivery of materials from the supply sources, more information as to whether drawings are available, as to patterns, as to delays in other shops, etc., than any one foreman possibly can have, and that it can advise the management intelligently regarding the causes of delays far better than the individual boss who is only in touch with his own immediate situation. Shown diagrammatically, the plant with a production department operates as shown in Fig. 1.

There may be 40 departments, all of which require information from the supply side of the diagram. Without a production department how is this information secured? We all know what happens. Each foreman or sub-foreman or workman simply hikes to the other department and gets whatever information he can, personally. When he gets it, he tells the boss and the boss most likely verifies it in some other way and then does something.

Comparing this with the production department method, what do we find? The production department knows what is wanted by each department and has a date when raw material should be in stock by the stores. They check this, in many cases weeks before the material is due in the shops and consequently are able to report to the management future delays they see that look to be unavoidable unless immediate action is taken. In other words, they report delays in time for them to be prevented, or when they cannot be prevented, in time for a change in program to be effected without loss of output.

It is not to be presumed that delays do not occur under this arrangement, but they certainly are very much reduced. The very nature of engine repairs is such that much information is not available just when it is needed, especially regarding defects which are revealed after stripping down. Such situations must be handled as they come.

The principle having been outlined, a word is necessary to show how the production department is synchronized as a living part of the organization and not an outside unit, as the diagram makes it look.

The man who sets the master schedule, who designates the actual engine numbers of all engines that are to constitute the shop output, must be the general shop foreman. In practice the superintendent, perhaps in conference with others, actually sets the schedule, but it is essential that the shop foreman be in on the layout so that he feels that it is his schedule and not that of a clerk on whom the blame for failure may carelessly be thrown.

In a shop where the planning department had been dropped, the following observation was once made to me: "It's all very well to have a schedule, but the schedule does not get the work." No schedule gets the work out if the foreman does not co-operate with those controlling it by making known the reasons for delays or failures to comply with the requirements of the schedule. A co-operative schedule does not advise the superior officer of delays in order to bring censure on a department, but with the idea of helping out by supplying more men, more machines or by redistributing work that is accumulating in one place so that the final completion dates may be met. When a schedule department tries to run independently of the shop, then it fails because it "does not get the work." When it operates in conjunction with the shop or when it is run, as advocated by the writer, "by the shop," then it succeeds because it is simply a concerted effort to attain a single aim.

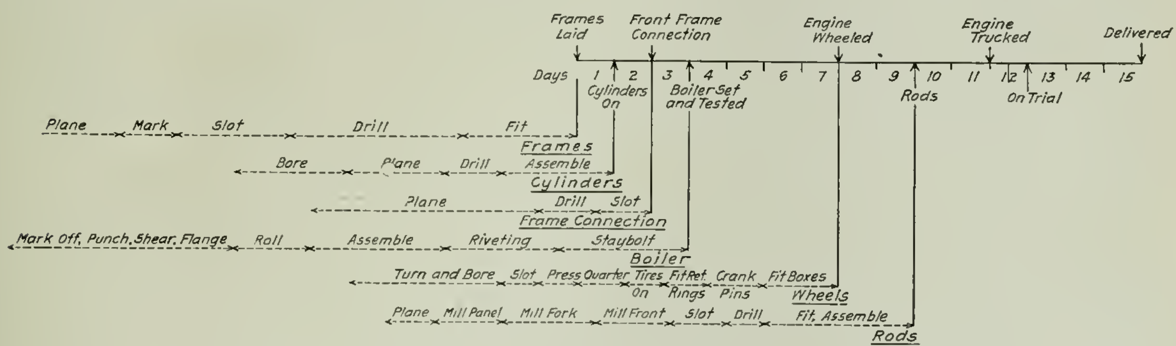
The following is a description of the Canadian Pacific production department methods as they are at present applied at the Angus Shops, Montreal. The methods of taking care of new work will first be followed, after which the same principle as applied to the repair work will be taken up.

For the purpose of this description the Locomotive Department only will be considered, the output being new and repaired locomotives, although it should be understood that the principles apply to all classes of output in all shops.

ROUTING AN ORDER OF NEW ENGINES

We will assume an order is placed to build a number of engines of a certain class and the management desire them completed by a certain date determined from past experience, a general survey of conditions and the known capacity of the shop. After the first one is delivered the balance is required, say, at the rate of four engines per month.

In all cases the first engine is desired as early as possible. In order to determine the best possible date of delivery of this first engine it must be found out which parts will take the longest time to deliver to the erecting floor and which parts have the most machining on them, since the delivery date can only be accurately computed when these larger items are scheduled. A list must be made up of all the large items: frames, boiler, cylinders, etc. Opposite each item on this list all the operations that have to be done on it are entered. Next the time each operation will take must be estimated. Adding up the time required by all the operations gives us the total machining or operation hours for each piece. To this time must be added an allowance of about five hours for each succeeding operation to take care of delays due to movement of material and awaiting attention at the next operation. It is evident that there must be some overlap at each machine to avoid constant delays while waiting for work. These times all totalled and divided by the number of available



This illustrates the method only and is not to correct scale

Fig. 2—Method of Determining the Date of Completion of the First of a Run of New Locomotives

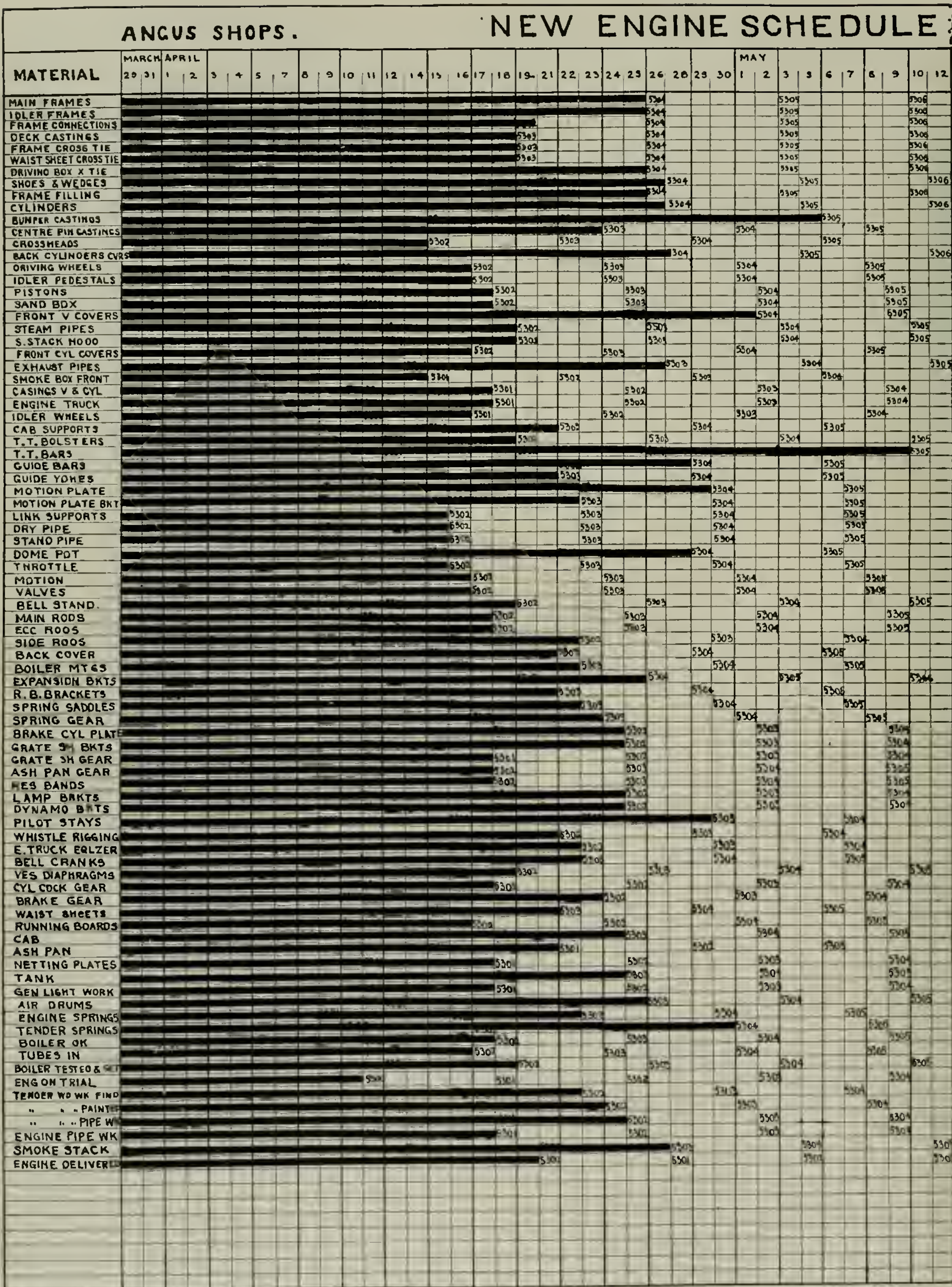
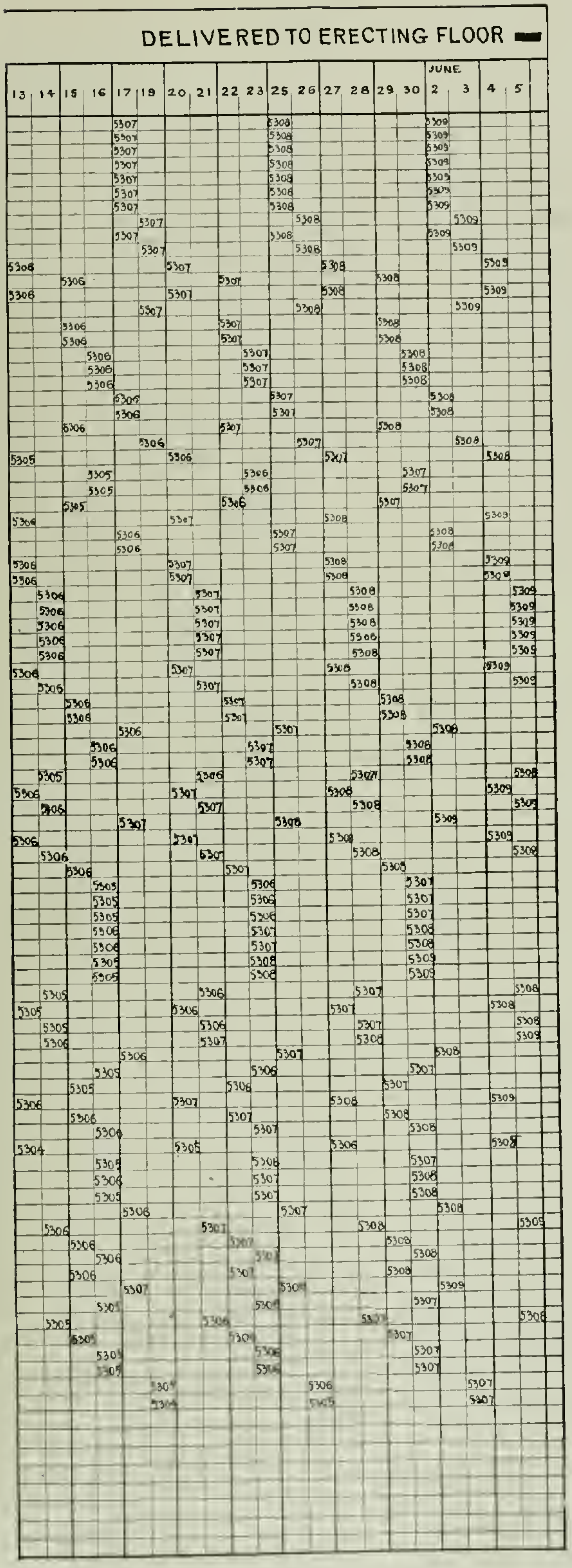


Fig. 3—Standard Schedule Form Prepared for an Order of New Locomotives, Showing the Method of Checking Off the



Completed Work by Extending the Heavy Lines

working hours per day give the number of days required for machining. In the case of castings the line-up must begin with the delivery of drawings to the patternmaker, time to make the patterns, time to cast, time to deliver and then all shop operations up to the delivery on the erecting shop floor. In cases where material, such, for instance, as plates for

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS SHOPS
PRODUCTION DEPARTMENT
APRIL 1919
SECOND PERIOD — WEST MACHINE SHOP

DATE	GUIDE BARS	MOTIONS	VALVES	BELL STANDS	MAIN RODS	SIDE RODS
April 7th	513 6301	3293 5300	5300 3293	741 1996	5300 1042	3293 5300
8th	3356 471 3955	2066 3356 3418	2066 3378 613	760 5300 2066	2066 3529	1042 2066
9th	848 3288	5301	3356 3418	810 613	3378 613 2599	810 3378
10th	3476 5070	3356 3410	5301 471	3356 3418	3356 3418	613 2599
11th	513 3408	471 3955	3955 2209	471 5301	471 5301	3356 3418
12th	5302 1109	2209 848	848 3376	3955 2209	3955 2209	471 5301
14th	3960 2601	3476 2053	2053 3288	848 3476	848 3476	3955 2209

Fig. 4—A Weekly Order-of-Work Sheet for Machine Shop Operations

boilers, is not in stock an allowance of the time required to secure delivery must also be included; obviously it is futile to set a scheduled date and expect to live up to it unless this provision is made. Purchased finished material must also be taken into account because the engine cannot be delivered minus any part.

Having determined the date of delivery of the frames,

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS SHOPS
PRODUCTION DEPARTMENT
APRIL 1919
ERECTING MACHINE SHOP
Delivery dates of material to Erecting Shop

DATE	GUARD STAYS	SPRING GEAR	BRAKE GEAR
Still due	848	2209	3418 3956
April 14th	3476 1109	848	2209
15th	2053	3476 1109	848 1109
16th	6169 3288	2053	3476
17th	3408	6169 3288	2053
19th	3475	3408	6169 3288
21st	5070	3476	3408
22nd	2601 3492	6070	3475

Fig. 5—A Weekly Order-of-Work Sheet

boiler and other large parts, eight days are added for erection up to the wheeling date and, say seven days more, which gives a final delivery date. Thus a final delivery date is arrived at on the basis of which a complete schedule for everyone to work to is built up, onto which all the various de-

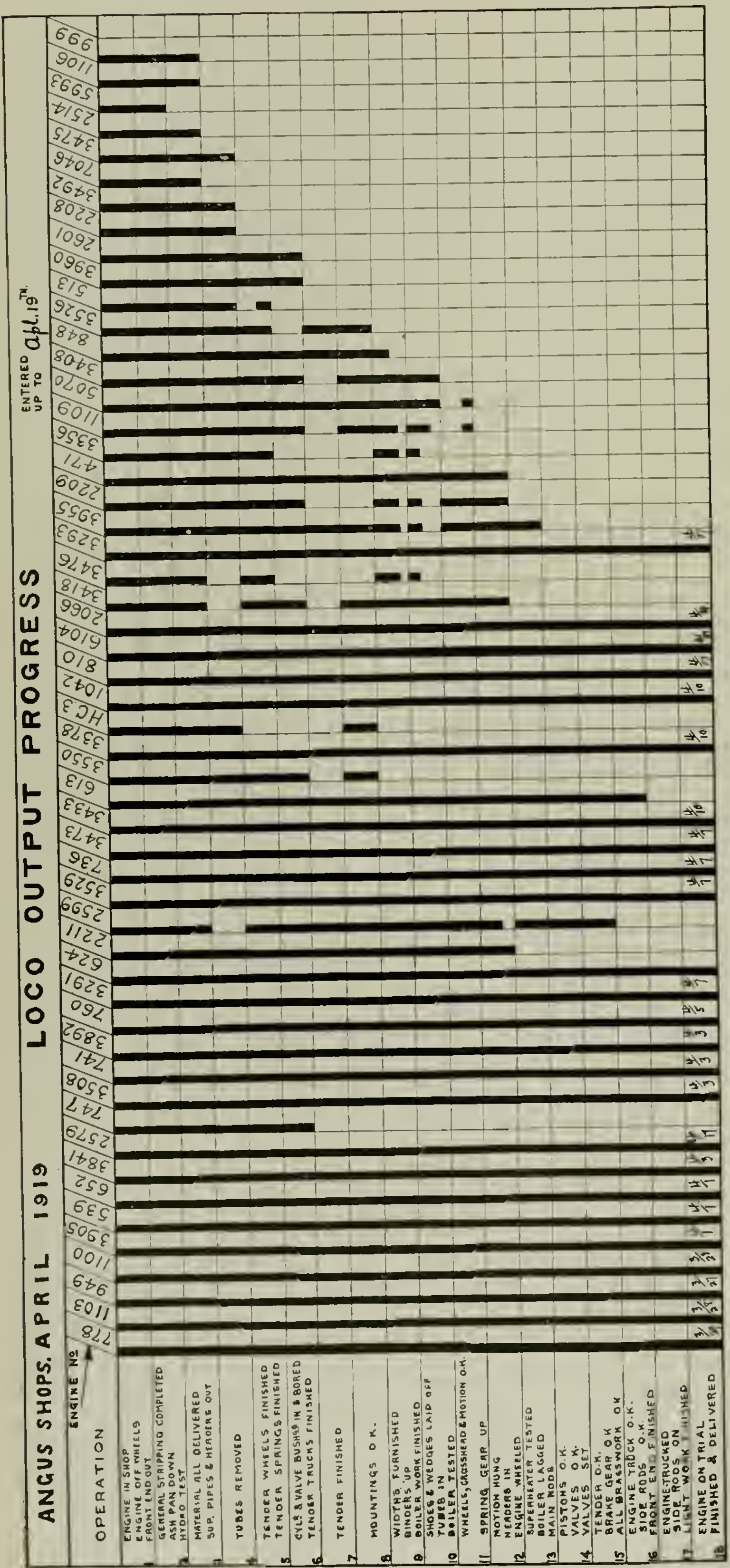


Fig. 6—A Graphical Presentation of the Progress of Engines Through the Shop

tails can be added showing the required delivery dates from all departments.

To determine the dates to be marked on the master schedule, the writer uses a graphic method which is simple and less liable to error than plain tabulation. Fig. 2 is a sample of such a computation, which is made on section paper, hours being shown on the horizontal scale. Starting with the last operation in each group, at the point when it is required to be delivered to the erecting floor and working backwards, all items are entered to scale. The final result in hours is easily converted to days, and actual dates entered on the master schedule. From this all the different shop foremen and chargehands are given details of finishing dates for the different operations and parts.

Our practice is then to take one of our standard schedule forms, Fig. 3, which are 24 in. by 22 in., and list all parts down the left-hand side. Along the top are inserted the dates of all working days and in the squares corresponding to the correct delivery dates for each part the engine numbers are entered. Having determined the proper date for the first engine, as illustrated in Fig. 2, it is a simple matter to insert the numbers for successive engines at regular intervals of six days or whatever is necessary to show their respective delivery date.

We thus build up a master schedule which is the foundation of the system and is also of much value to the shop managers to show them just how each engine stands. As each part is delivered a production department man crosses out the items by extending the thick black lines in each case, thus giving a graphic and plain representation of the situation and incidentally emphasizing items not on time for his personal investigation.

At the Angus Shops engine repairs as well as new engines are being handled and in order to condense the instructions both new and repair engine dates are included on the same sheet. The object is to give each shop foreman but one order-of-work sheet covering the work of his department.

According to the nature of the work in each department, either weekly or daily order-of-work sheets are issued, samples of which are shown in Figs. 4, 5 and 7. These sheets go to the foreman actually directing the workmen, and are copies of that part of the master schedule which concerns each particular foreman for the day or week, as the case may be. It is the duty of the production department men to check over every shop every day with the foreman to determine whether all work scheduled is completed or whether and why it is delayed. On his return to the office the production department man marks up the master schedule and then issues the next day's sheets. These are always issued before quitting time in the evening so that foremen can lay out their work ready for the next day.

The first line of each order-of-work sheet is labelled "Still due" and represents work that was due but not delivered on time. A summary from all sheets of the work which is late is given every day to general shop foremen and the shop superintendent for their personal attention. It is thus seen that the whole work is covered by a checking system that releases the foremen and management generally, from a chore which previously occupied a considerable portion of everybody's time, giving more time for taking care of shop difficulties, of which there are always plenty.

Routing Repair Engines

For routing engine repairs a master schedule form slightly different from that for new engines is used. The difference

CANADIAN PACIFIC RAILWAY COMPANY
ANGUS SHOPS

PRODUCTION DEPARTMENT

DAILY ORDER OF WORK SHEET

STRIPPING OPERATIONS FOR APRIL 8th, 1919.

ERECTING SHOP:	
Engine 2601	S.B.front, headlamp dynamo and rails. Main and side rods, grates, brake gear, engine off wheels, dome casing pump.
Engine 2228	Engine off wheels X
Engine 513	Motion and valves X Steam and exhaust pipes X Headers out, mountings stripped and delivered, dry pipe and stand, pipe out. All parts cleaned and delivered, buffer beam and pilot if required.
Engine 3960	Engine off wheels, Pump X Hydro test, motion and valves, spring gear, steam and exhaust pipes.
TANK SHOP:	
Engine 2601	Netting and plates out
Engine 3960	Netting and plates out, ash pan removed.
Engine 513	Ash pan removed
BOILER SHOP:	
Engine 3546	Tubes cut and removed X
Engine 848	Ditto X
JACKET SHOP:	
Engine 2601	Strip firebox complete for test
Engine 2228	Ditto Strip cylinder casings and jacket
Engine 513	Ditto

X means one day late.

Fig. 7—Daily Order-of-Work Sheet for Stripping Operations

is, however, only in the form, because of the number of engines to be carried. A line is provided for each part or section of the work scheduled and working dates are carried across the tops, as in Fig. 3. One month only is carried on the repair schedule, whereas over two months are represented on the new engine schedule, each form having been found to be the convenient size to cover the conditions to be taken into account in each case.

As each engine arrives at the shop an inspection is made for missing and broken parts, report of which is checked up with the road report of repairs to be made. From these the general foreman with the chief scheduleman of the production department, decide how many days in the shop are to be allotted to the repairs. The scheduleman then proceeds to apply a ten, fifteen, eighteen, etc., day standard schedule to the engine, adding in where necessary an allowance for such specific repairs as broken frames, new cylinders or heavy boiler work. After this the engine number is entered on the master schedule under the correct date for each operation and then included on the daily order-of-work sheet as they come due.

All acquainted with engine repair work know that there are delays due to unforeseen boiler work or unreported defects that are not discovered until after stripping, which necessitate setting back some dates and advancing others as the work progresses. This condition is taken care of by the production department by issuing the form shown in Fig. 8, to those concerned. It is not issued to such departments as are able to get ahead on their work without interfering with the general program. It is good policy not to change any schedule unless absolutely necessary. If a department can handle its work on the original layout, it is better to let them do so, even if the work is not needed on the date scheduled. This policy reduces shop costs because foremen do not have to break in on work that may be started to give preference to something else.

Since the primary object of the production department is to reduce the time and cost of the work, delays and their causes are of great interest to us. The direct effect of routing work is to reduce the time between jobs, and this is especially important in that it increases the capacity of the shop without additional pit space.

A production system of this kind is very much comparable to the recording gages in a power plant. The sheets show clear all the time the work comes through on time, but if a department for any reason gets out of order, just as the gages

CHANGE OF DATE NOTICE

Date ....April 17th........

Foreman....West Machine....

Please note that out Date of Engine....3516....

has been set back on account of....New Tube Sheet....

Engine is re-scheduled for....May 15th....

Schedule Dept.

Fig. 8.—Form Used to Notify the Foremen Concerned, of a Change in the Schedule

in the power house show trouble, so will the record of "lates" show it in the shop and continue to do so until the trouble is rectified. This, of course, is exactly what is aimed at.

A weekly progress sheet is shown in Fig. 9. This is issued to all general foremen and piece-work foremen as a means of general information to those not getting detail order-of-work sheets. It gives the engine number, class of repair, date in shop and date scheduled out, of every engine being worked on in shop. This information thoroughly posts all concerned on the general shop standing. One file of these sheets, with all engine reports, is kept in the general foreman's office, where the master schedule board is also located, so that all can see them and watch the shop progress insofar as it concerns them. By making all production department information and data available in this way, every foreman becomes conversant with how it all is developed and consequently has confidence in it. This confidence begets results.

The method of making up and checking the order-of-work sheets has been described, but a little further information may be of interest. Fig. 4 shows a machine shop sheet covering deliveries of guide bars, motions, valves, bell stands, main rods and side rods. In this department, as on other work of similar character, is shown all principal work due for a week. In this case the work of more than one chargehand is shown on the sheet; this is simply to economize on the typing which comes in a rush at the end of each day. On Fig. 5 it will be noted that four engines show on the "Still due" line, and naturally get first attention. Fig. 7 is one of the daily operation sheets which is issued to the stripping gang bosses. Here it is seen that the exact operations to be performed are enumerated, and it can readily be appreciated that when a department which is falling down gets a sheet of this kind the information is of the real helping-hand nature because the planning is already done. In our case the stripping of engines now takes just 50 per cent of the time it did three months ago, a result which has been accomplished simply by distributing the gang according to the daily order-of-work sheets.

Another chart of interest to the shop management is the graphical representation of engine progress. Fig. 6 contains along the top all the engines in the shop in the order in which they came in. On the left is listed in 54 items the principal work in the order in which it is to be done on a general repair. As each item is completed the black line is extended downward towards the bottom horizontal line, which represents completion of the engine. This chart is also used as a check on output, but principally as a check on costs. It instantly gives a line-up on the engine progress, which is compared with a corresponding line on another chart which represents the cost to date.

It is equally as important to keep a check on engine costs as on output. As soon as practicable after the receipt of complete information as to what has to be done on an engine, an estimate of the cost is prepared. This estimate is based on the average cost of the individual class for the past year plus additions for all specific repairs that are known. This total cost is apportioned to the different shops according to the amount of work each has to do, and the whole is graphically plotted daily on a c[illegible] similar to Fig. 3, except that the allowance is indicate[illegible] l mark to which the heavy black line of actual cost [illegible] proaches. From this chart, together with Fig. 9, en[illegible] which the cost is running high quickly can be pick[illegible] d the reason learned before it is too late. Often it is [illegible] at high costs are due to poor distribution of labor in some particular department, which is brought to the notice of the proper party for rectification.

CANADIAN PACIFIC RAILWAY CO.

ANGUS SHOPS

PROGRESS SHEET, WEEK ENDING APRIL 5th 1919.

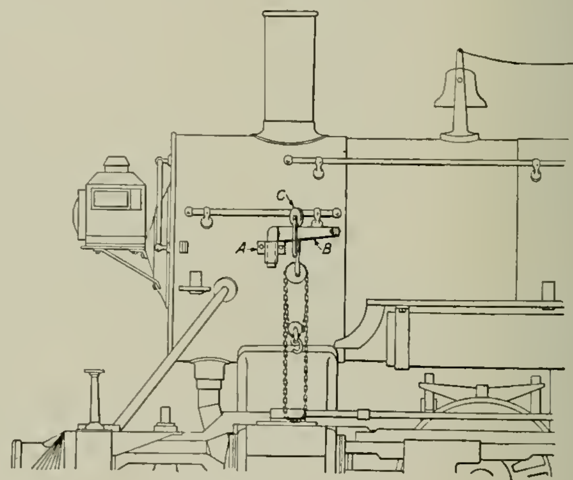
Div.	Engine	M.	T.	P.B.	Date in shop	Out shop
Q	2658	3			3-19	3-31
A	3508	1	1		3-7	4-1
O	3841	2	1		3-6	1
Q	3943	3			3-18	1
A	2552	2	1-1		2-25	2
A	3892	1	1		3-18	2
O	736	1	1-1		3-19	2
O	741	1	1		3-8	3
O	170	1	1-1	4	1-9	3
O	1996	1	1-1	2	1-3	4
Q	3284	1	1		2-19	4
Q	6104	1	1		3-26	4
	5300		New Engine		3-19	6
Q	760	1	1-1		3-11	6
O	3433	1	1-1		3-17	7
Q	3473	1	1		3-18	7
N B	3529	1			3-16	7
Q	3378	1			3-24	8
N B	3293	1			3-27	8
Q	810	1			3-21	9
Q	709	3			3-22	9
	5301		New Engine		3-27	10
O	1042	1	1-1		3-21	10
O	2699	1	1-1		3-14	11
O	3418	1			3-27	11
D A	40				4-	11
O	613	1	1-1		3-20	12
A	7083	1			4-	12
O	2209	1			3-28	12
O	2066	1	1		3-25	12
	3476	1			3-28	14
	5302		New Engine		4-	14
A	3966	1			4-	14
Q	3546	3		W	4-	16
N B	3356	1			4-	16
O	2053	1	1-1	1	3-28	16
Q	3288	1			4-	16
Q	3408	1			4-	17
Q	5070	1			4-	17
	848	1			4-	19
Q	3520	3		W	4-	19
	5303		New Engine		4-	21
Q	1109	1			4-	21
Q	3388	1			4-	22
A	3483	1			4-	22
O	2054	1	1-1	1	3-28	23
	5304		New Engine		4-	23

Fig. 9—Weekly Progress Sheet Issued to General Foremen, Who Do Not Receive Detail Order-of-Work Sheets

In common with all other roads, war-time conditions took away a lot of skilled men who knew the back shop practices and brought into our shops a lot of unskilled railway mechanics. But the management is still responsible for getting the output at the right cost. The methods here outlined are in principle the same as laid down at Angus shops by H. L. Gantt several years ago, simply modified to give desired results with minimum expense as present conditions and common sense dictate.

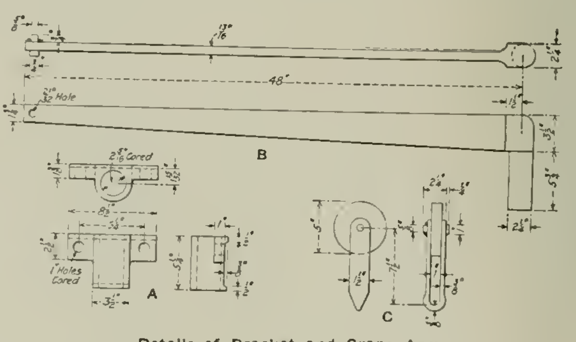
A LIGHT CRANE FOR FRONT END WORK

To facilitate the handling of valves, steam chests, guides and other parts at the front end of locomotives a light capacity crane has been devised in the Duluth & Iron Range shops which is giving very satisfactory service.



Crane Attached to a Locomotive

A cast steel bracket *A* is fastened permanently on each side of the smokebox of all engines. This bracket has a socket to receive one end of a forged steel crane arm *B* fitted with a trolley *C* to which a chain hoist is attached. Two



Details of Bracket and Crane Arm

of these cranes are kept in the main roundhouse and one at each outside point where repairing is done.

This crane may also be used for any other light work in the roundhouse or shop by placing the brackets *A* in convenient places such as at presses, for handling crank pins and driving box brasses.

Meeting of the Fuel Association

Fuel Conservation Problem Discussed by a Large Attendance at the Eleventh Annual Convention

The International Railway Fuel Association held its eleventh annual meeting May 18 to 22 at the Hotel Sherman, Chicago.

ADDRESS OF PRESIDENT PYLE

Mr. Pyle in his opening address made a plea for economy in fuel, speaking in part as follows: Those who have not had a practical working knowledge of the conditions under which the railroads labored during the past year have no conception of the task which has confronted all connected with the movement of transportation. The railroads have

L. R. Pyle (M. St. P. & S. S. M.)
President

C. M. Butler (A. C. L.)
Vice-President

J. B. Hurley (Wabash)
Vice-President

H. B. MacFarland (A. T. & S. F.)
Vice-President

J. G. Crawford (C. B. & Q.)
Secretary-Treasurer

been the backbone of our war preparation and without them we would have failed miserably.

They will also be the backbone of our country during the reconstruction period, and it behooves every man connected with the American railroads seriously to consider just what part he is to perform. We will be called upon to do things which at first glance appear almost impossible of accomplishment, not because what we will be asked to do is impracticable but because of the difficulty of getting others to put these things into practice. If we are the men for the job we must get results and this will be the measure of our ability as railroad men. Regardless of who operates the railroads during the coming year this fact is clear and unequivocal. It will be necessary to produce better transportation facilities, both freight and passenger, at a lower cost than ever before. Wages and cost of supplies entering into the operation and construction of a railroad are higher than ever before. To offset this we must eliminate waste.

There is a wide field for discussion as to how economy can be realized on the locomotive, in the roundhouse or stationary plant, by the transportation man in more efficient methods of train handling, by the mechanical man through better maintenance of locomotives and cars, by the maintenance-of-way man through better track conditions and fewer slow orders, or by the car and air brake man in maintaining the air brake system and so taking care of lubrication to eliminate hot boxes, or by the yardmaster in making up trains efficiently.

The results obtained through effecting economies in fuel are far-reaching and assist in speeding up the movement of transportation, which, in turn, effects other economies. Everything done to save coal has a beneficial effect on all other angles of railroad operation. Even now operating officials do not fully realize the tremendous opportunity for a material reduction in the cost of transportation by specializing on the second largest item of expense on a railroad, namely, that of fuel.

Although some roads have and are eliminating fuel waste through systematic efforts, we have as yet barely scratched the surface. To get the real reduction in cost that is possible and absolutely necessary a more practical interest has to be shown by general operating officials and a closer co-operation must exist between the heads of the different departments. This does not mean that there is no co-operation between the heads of the different departments, but to continue fuel conservation in a haphazard manner the maximum economy can never be attained.

A fundamental principle of fuel conservation is co-operation, as even the slightest error in one department often disturbs the entire organization. A chain is no stronger than its weakest link, and a federal manager can have ever so good a fuel organization, but if a superintendent fails to co-operate fully there is a break in the chain and the railroad suffers. It is not so much individual effort that is needed as a practical give-and-take co-operation from the chief operating official to the smallest individual on a road.

Hale Holden, regional director of the Central Western region, was to have delivered an address, but was unable to attend. W. B. Storey, federal manager of the Atchison, Topeka & Santa Fe, spoke, in part, as follows:

We who are handling the railroads are vitally interested in saving fuel. We must save fuel in order to get back to normal conditions. On the Atchison, Topeka & Santa Fe the fuel bill for engines alone was one-third of the total transportation expenses and one-seventh of the total operating expenses during 1918.

There are many difficult phases to the problem. If we could make fuel economy the prime consideration, the matter would be greatly simplified, but service to the public must receive the first attention. Another serious phase is the labor situation which we must handle differently from what we did in the past. We must get these problems before the men as matters that concern them and the railroads with which they are connected.

ADDRESS OF FRANK McMANAMY

The position of the Railroad Administration is in many ways analogous to that of a tenant, the landlord being represented by the corporate interests. The landlord whose rental is fixed hesitates to make improvements which do not have the effect of increasing his revenue regardless of the saving they may effect for the tenant; for that reason it is necessary for us to do our best to make savings with the equipment, facilities and the organization we have.

It is comparatively easy to make a substantial saving in the cost of locomotive fuel by wholesale application of recognized fuel saving devices. However, the application of these devices involves charges to capital which must be borne by the railroad corporations and the acceptance of these charges by the corporation is not always easily obtained. But if we can not install those improvements which will effect fuel economy, there is no reason why we should not maintain in thoroughly good condition those devices with which locomotives are equipped, nor any reason why we should not make every effort to save fuel by eliminating waste of steam and water.

Conservation of fuel from the Railroad Administration standpoint requires careful supervision by the Fuel Conservation Section and close co-operation on the part of practically every department in the Railroad Administration, and in this the International Railway Fuel Association can be especially helpful. Fuel economy is not, as a rule, accomplished by saving one huge sum, but the huge sum which it is possible to save is made up of the accumulated results of many small items. We gain nothing from conventions unless we make use of the knowledge obtained. It is easy to attend a convention of this kind, and by discussion bring out some most valuable points in connection with conservation of fuel, but it requires real courage and perseverance to go back home and consistently practice what we preach.

Conservation of fuel is one of the important matters before the Railroad Administration during the period of government control, and will be no less important when that period has passed. It is the desire of the administration to have the sympathetic co-operation of the International Railway Fuel Association and all of its members as individuals in effecting the conservation of fuel. The administration desires to co-operate with the members of the Fuel Association in the purchase, inspection, weighing, distribution, handling and accounting for fuel, as well as in its economical use to bring about the greatest possible saving.

The administration will aid in every possible way and will be helpful in every way that a central organization can be under the present method of operation, but if we are to be successful we must have teamwork in getting the very best we can out of what we have.

OTHER BUSINESS

A report on Front Ends, Grates and Ash Pans was signed by H. B. MacFarland (A., T. & S. F.), chairman; W. J. Bohan (N. P.), E. B. DeVilbiss (Penn. Lines), J. P. Neff (Am. Arch. Co.), and Frank Zeleny (C., B. & Q.).

A report on Pulverized Fuel was signed by W. J. Bohan (N. P.), chairman; H. T. Bentley (C. & N. W.), H. B. Brown (L. V.), R. R. Hibben (M., K. & T.), D. R. MacBain (N. Y. C.), J. H. Manning (D. & H.), H. C. Oviatt (N. Y., N. H. & H.), John Purcell (A. T. & S. F.) and L. R. Pyle (U. S. R. A.).

Other papers submitted were: Teamwork of Enginemen and Firemen; Locomotive Fuel Losses at Terminals; What Can a General Operating Officer Do to Promote Fuel Economy? Certain Essentials; Dirt in Coal; Equated Tonnage and Its Relation to Fuel Consumption; Lame Engines and Their Effect on Fuel Consumption; Storage of Coal by Railroads During 1918; Fuel Department Organization; Co-operative Research and the Railway Fuel Problem; The Effect of Reducing Exhaust Nozzles to Overcome Front End Air Leaks; Internal Combustion Versus Steam Engine for Small Stationary Plants. Abstracts of these reports and papers will appear in subsequent issues.

THE NEW OFFICERS

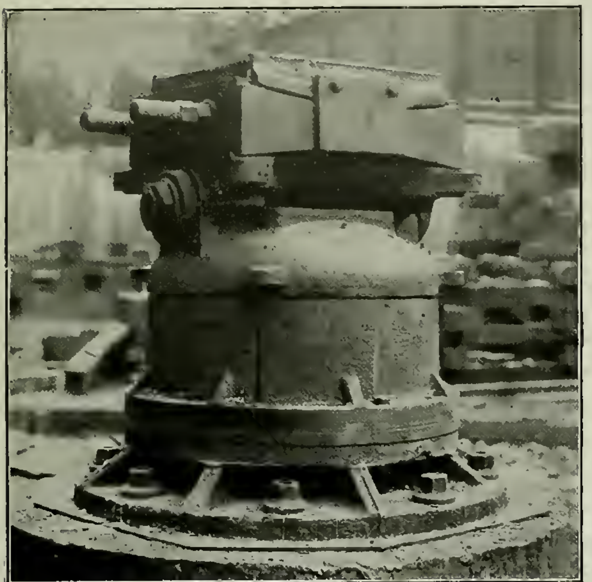
The following officers were elected: President, H. B. MacFarland (Atchison, Topeka & Santa Fe); vice-presidents, W. J. Bohan (Northern Pacific), J. B. Hurley (Wabash), and W. L. Robinson (Baltimore & Ohio Western Lines); executive committee, J. W. Hardy (U. S. R. A.), M. A. Daly (Northern Pacific), C. M. Butler (Atlantic Coast Line), L. J. Joffray (Illinois Central), C. C. Higgins (St. L.-S. F.), and J. M. Nicholson (A. T. & S. F.).

Railroad Employees' Subscriptions to Victory Loan.—Officers and employees on railroads under government control throughout the United States subscribed a total of $138,637,250 to the Victory Liberty Loan. The returns from the seven regional directors show that out of a total of 1,841,267 employees, 1,417,042, or 77 per cent, subscribed to the loan. Employees on 13 roads showed subscriptions of 100 per cent. Railroad officials and employees subscribed a total of $184,868,300 to the Fourth Liberty Loan. General offices of regional directors of Southern, Pocahontas, Allegheny, Southwestern and Northwestern regions subscribed 100 per cent, the general office of the Central Western region 99 per cent, and the general office of the Eastern region 96.8 per cent.

A Turntable of Unique Design

P. R. R. Develops Adjustable Center, Supports Table at Three Points and Puts Tractor at Each End

A CENTER bearing, adjustable vertically over a range of 1 in. by means of screw operated wedges, is one of the main features in the 110-ft. turntable recently designed by the Pennsylvania Railroad and now being installed at several of its more important engine terminals. This vertical adjustment has permitted the development of



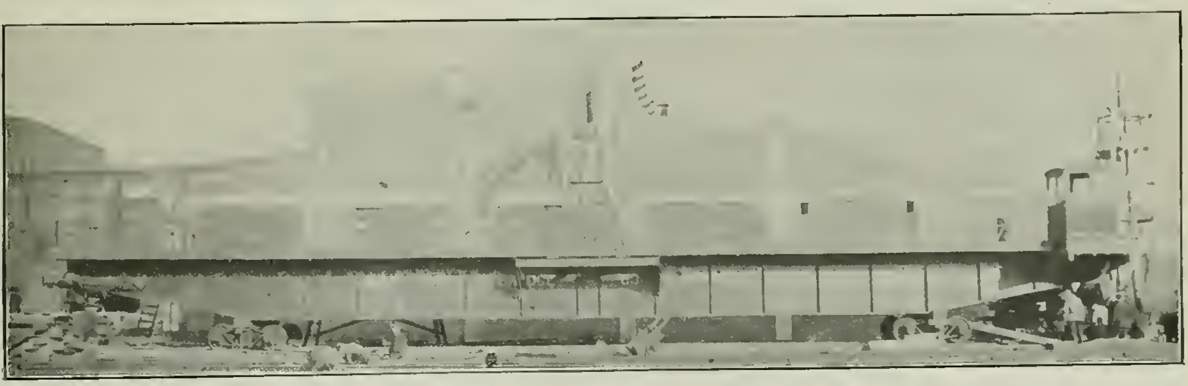
The Center Is Adjustable By Means of Screw Operated Wedges

plans for tables of the three-point supported type, the design of which includes many other novel and interesting features and avoids the use of the usual balanced type with its objectionable features, particularly in tables of such extreme length.

The 110-ft. tables were designed in anticipation of the increased requirements at engine terminals incident to the impending introduction into service of the new Mallet engines of the HC1s type, several of which are now under construction in the company shops. These locomotives have a wheel base of 97 ft. 3¾ in., an over-all length of 105 ft. 9¼ in., and an estimated weight of 555,000 lb., exclusive of the tanks, which weigh 219,000 lb., or a total weight complete of 774,000 lb. Owing to the extreme depth of girder required for a balanced table of such great length and further because of the conditions under which a turntable must operate, in which it is difficult to spot a locomotive of this size and weight with any degree of accuracy, it seemed inadvisable to build a table of the usual balanced type. Furthermore, the tendency of all balanced type tables to teeter has an undesirable effect on the approach rails and outside trucks, due to pounding, which is augmented as the length increases. It was therefore decided that the new tables should be of the continuous girder three-point supported type, in which the weight of the table and its load is distributed over the center and the four end trucks. Exclusive of the tractors and center the table, ocmplete with the end trucks, has a weight of 75 tons.

Reliability of service and low maintenance costs were the main objectives of the design and in the preliminary studies particular attention was given to the requirements of traction. Time studies were made of the various table operations at existing tables and the information secured was utilized in the design of the tractors to insure that the operating cycles of the new table, with its greater loads, would not exceed those of the smaller tables and that the new tables would easily turn an engine end for end in 45 sec. Special attention was given to starting, accelerating and stopping the table to avoid excessive whip action, with the result that the maximum acceleration does not exceed 0.35 ft. per sec. and the maximum circumferential speed of the table is 240 ft. per min. Reliability of service has further been provided for by the utilization of two tractors, either one of which is capable of moving the table under emergency conditions. The two tractors provide sufficient traction to eliminate the necessity for the use of sand and a separate circle rail for the tractors.

Low maintenance costs are further insured by the permanent type of construction employed throughout the entire structure, including the foundation, the circle wall and rail, the bridge, the deck, and the electrical apparatus. In the design of parts simplicity, accessibility and interchangeability were the objectives. Sheet metal was avoided in the selection of materials and cast iron was used wherever possible



Pennsylvania 110-Ft. Turntable Designed for Three-Point Support because of its resistance to corrosive action. For the same reason galvanized iron is used for hand rails.

To eliminate the pounding out of the approach rails and approach rail supports at the table ends and at the approach rails, cast steel end ties were installed at the ends of the turntable bridge and iron coping castings were used on the coping walls, the cast steel end ties being aligned accurately to the center line of the table and brought to alignment level by means of stereotype metal between the end tie and the girder flange and secured to the bridge with eight 1-in. bolts. Opposite tracks are also perfectly aligned. The same permanent character of construction is employed in the pit, where the circle rail of Cambria No. 539, 150-lb. section, bent cold, is held in place on 33 iron support castings firmly secured to the concrete.

The adoption of the three-point supported type table permitted the use of girders only 6 ft. ½ in. deep, reducing materially the depth of pit required. These pits are drained from the center to a sump from which the discharge is by gravity or syphon, according to local conditions.

THE ADJUSTABLE CENTER

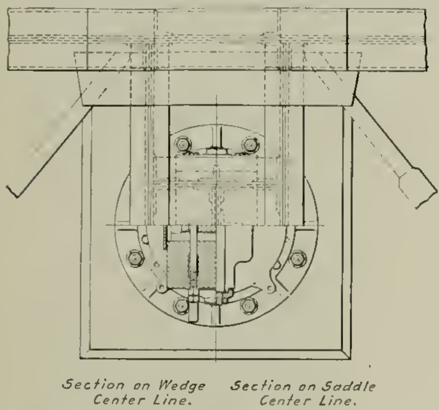
In order that the table function properly on three points of support it was necessary that one of the supports be adjustable so far as vertical alignment is concerned. This adjustment is accomplished in the center by means of screw operated wedges, the total range of adjustment being 1 in. As the load of the table comes down on the sole plate it bears on wedges which in turn bear, through the lower wedge casting, on the equalizing hinge pin, the center of which is at right angles to the longitudinal center line of the table, thence on the thrust bearing proper. This thrust bearing is of the roller type with a babbit liner between the lower roller race and the center casting to insure uniformity of bearing pressure. The load from turntable center is transmitted to the concrete center pier through a ¼ in. linotile liner, which insures a uniform, resilient bearing for the steel casting.

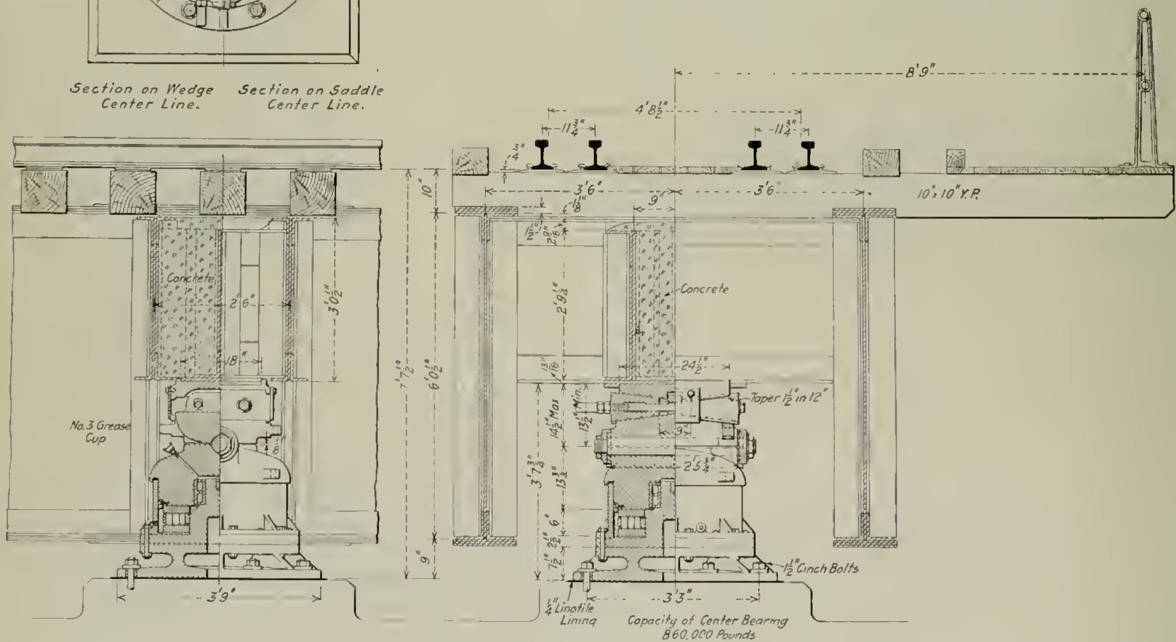
The capacity of the center bearing is 865,000 lb., and it is fully grease lubricated. It has been designed and built with a view of making it accessible for inspection or repairs. The upper half of the center proper can be removed from the base casting and the entire center slid out of position and passed up through the deck of the table. To perform this operation it is only necessary to jack up the table approximately 3 in. All the adjustment wedges and the wedge screws are thoroughly protected against corrosion and grit. The center is all of steel with the exception of the housing shell, which is of cast iron.

TRUCKS

Each end of the table is supported on two, two-wheel end trucks with cast steel frames and hinge connection centers. The hinge casting is provided with a compound angle in order to give proper angularity in all directions. The center line of each hinge pin is in a radial plane passing through the common center of rotation, in which it has vertical angularity sufficient to take care of the circular travel of the truck. The truck wheels are all 30 in. in diameter, coned, with steel tired treads and cast iron centers. They are provided with roller bearing centers with the bearings enclosed in labyrinth casings, the details of which will be made clear by an inspection of the truck drawing, and are fully grease lubricated.

The truck hinge castings as well as the steel end ties on top of the girder are lined to the girder flanges by means of





General Arrangement of the Turntable Center stereotype metal. The trucks each have a capacity of 186,000 lb. and travel on the same circle rail as the tractors. They may be removed by taking out the hinge pins without removing the hinge castings from the girder.

TRACTORS AND TRACTOR CONTROL

Two tractors are used on each table to give uniform torque action on each end of the table in starting and stopping, as well as to afford reserve power to meet emergency demands. They are operated in multiple from one controller located in a cab on one end of the table.

There are three points of particular interest in connection with the tractors and their control. The first is that two motors are used, one on each tractor, of approximately 30 h. p. each. Considerably more power is required than to operate a type of table in which the locomotive is balanced on the center bearing, but with the two tractors the operation is fast, is always dependable, and in an emergency one of the tractors working alone is capable of operating the table.

The second point of interest is the controller. A type of controller has been developed which is used to control one or both motors, and which may be used on any table of this type, irrespective of the kind of electric power that may be available. The same controller may be used for direct current, single phase alternating current, three phase alternating current and three-wire or four-wire two phase current.

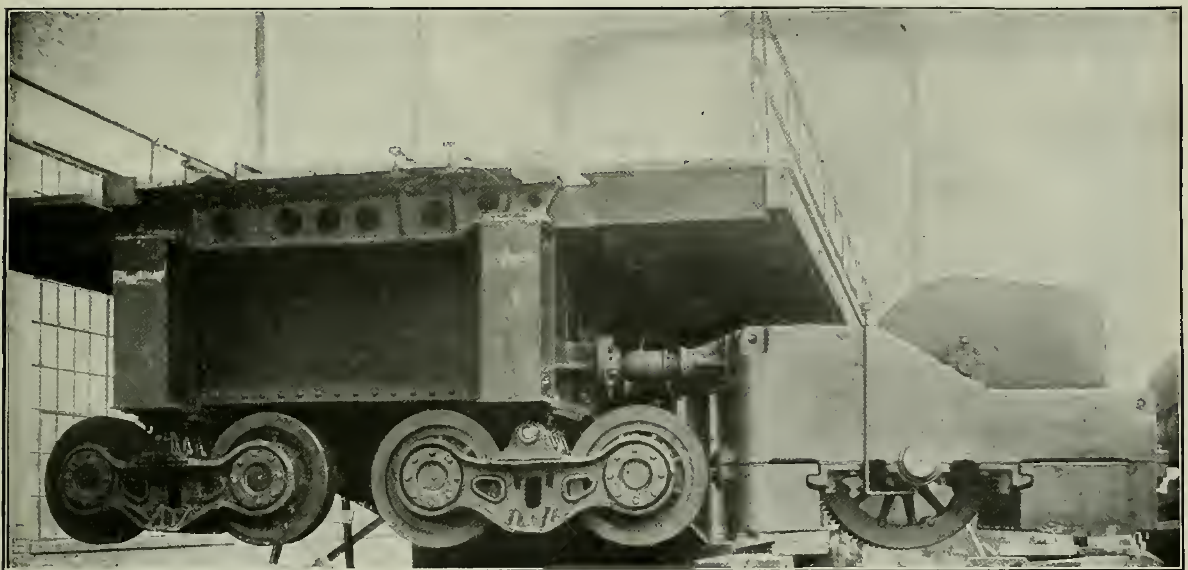
The third point of interest lies in the fact that the motors are equipped with solenoid brakes. The brakes are applied instantly when the controller is moved to the "off" position and are released automatically when power is applied. The brakes are adjusted so that the braking effort corresponds to the maximum torque of the motor. The solenoid brakes make it possible to operate this type of table without any of the so-called locking devices to hold the table in alinement with the approach tracks.

For direct current, 27½ hp. motors are used and 30 hp. motors have been adopted for alternating current. Power is transmitted from the motor to the driving wheels through two sets of gears and an intermediate shaft, with a total gear reduction of 25 to 1. As the tractor is provided with plain cylindrical tires, it was necessary to include in the design a suitable thrust bearing to care for the lateral thrust of the drive wheels. This thrust bearing is located on the inner side of the tractor frame.

In case of accident to either motor or to any part of the driving mechanism, electrical cut-outs are provided for taking the damaged motor out of service without affecting the operation of the other motor, while the solenoid brakes can be blocked in the "off" position. A motor may be disconnected mechanically by removing the split main gear or by removing the motor.

The two tractors engage the table through ball and socket connections located at the end of the stabilizing arms. The relation of the joint locations to the plane of the driving wheel precluded the use of hinge joints. All bearings of the tractors are grease lubricated. Each tractor weighs approximately 23,000 lb. in working order, giving a total tractive effort of 12,000 lb. per table.

The tractor frames on account of the weight required are made of solid cast iron with suitable ballast weights suspended from the lower surfaces. Special attention is given to the machining of all mechanical parts to insure absolute interchangeability for repairs. All gears are fully enclosed against the weather. The tractor wheels have cast iron centers, steel tires and are provided with cast steel cut driving gears. The bearings are all of brass.



The Trucks and Tractor in Place

When operating at night the table is lighted by floodlights on each end which illuminate the approach rail ends. The operator's cab is electrically heated and is lighted only with a small, well shaded lamp to keep down the reflection at night.

CURRENT COLLECTOR

Overhead current collectors for the usual type of turntables must be suspended from the overhead wires, as the portal over the center of the table must move back and forth over a considerable distance when the locomotive is moved on or off the table. Since the three points of support prevent the table from rocking on the center bearing, the collector in this case is bolted securely to the center of the portal.

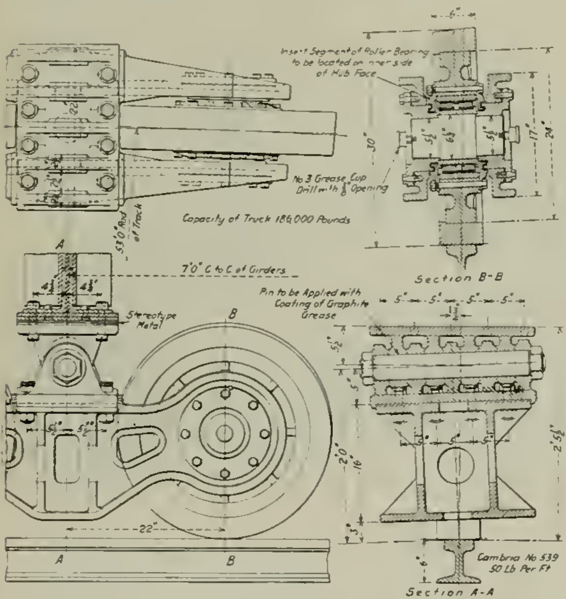
The collector in itself is of particular interest as it is made up of standard parts, bolted together, and may be used for direct current, or one, two or three phase alternating current by simply bolting together the required number of parts. It is weather, gas and steam proof.

Structual steel poles placed on opposite sides of the enginehouse circle support the overhead wire. One messenger wire is provided instead of the usual two, and it is not required to support the current collector. The only function of the messenger is to support the current carrying wires and to prevent rotation of the stationary part of the collector. The messenger is supported rigidly on one tower and on the other is fastended to one end of a weighted bell crank which insures uniformity of tension on the messenger wire at all temperatures.

PIT AND BRIDGE CONSTRUCTION

In order to insure no settlement at the coping wall on account of the pounding received in service. iron coping castings with 1-in. walls were employed instead of wooden sills. These castings are arranged one for each approach track and are thoroughly embedded in and bolted to the concrete. They are accurately aligned to the approach tracks and weigh about 9,000 lb. each, are 5 ft. 6 in. long, 12 in. deep and 30 in. high.

The circle rail on which the trucks and tractors run is 106 ft. in diameter and is supported on 33 castings each



General Arrangement of the Trucks

9 ft. 4 in. long, 10 in. high and 12 in. wide, with 7/8-in. walls. No sand is used in connection with the operation of the tractors because of the ample capacity of the tractors themselves. This feature eliminates the resistance of the sand to rolling of the trucks.

The cast steel end ties on the bridge have a maximum depth of 12 in. a flange width of 5 in. and a minimum width of 8 3/8 in. The sections are 1 in. thick. They support both the traction rails and the guard rails and are lined to the bridge girders by means of 3/8 in. of stereotype metal.

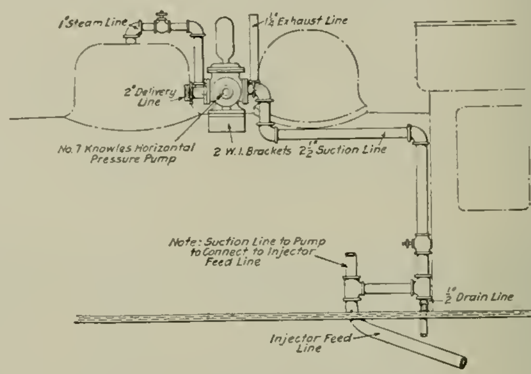
The design of this table was developed under the direction of A. S. Vogt, formerly mechanical engineer, who has now retired.

Tables of this type have been installed at Pitcairn, South Philadelphia, Erie, Kane and Renovo, Pa., and at Gardenville, N. Y. Others will be installed in the near future at Wilmington, Del., Youngwood, Pa., Pitcairn (Pa.) (emergency table) and at East Altoona.

FIRE PUMPS ON SWITCH ENGINES

BY J. H. B.

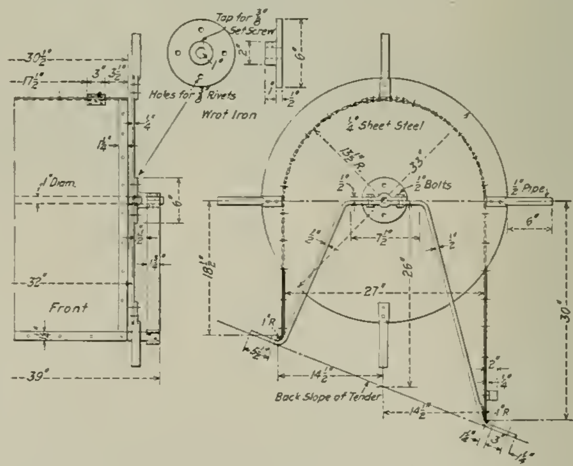
An arrangement for fire pumps on switch engines, in which the pump is mounted on top of the boiler, is shown in the illustrations. A horizontal pressure pump of the capacity required is placed between the sand box and the steam dome with a 1 in. steam line leads from the dome



Fire Pump Installed on the Locomotive

to the pump, which delivers the water through a 2 in. delivery line provided with a hose connection. Water is drawn from the tank to the pump by means of a 2½ in. suction line which connects to the injector feed line just above the running board.

The hose reel is mounted on the sloping top sheet of the tank where it is easily accessible so that in case of fire the



Hose Reel as Applied to Tender

hose can be unreeled readily and connected to the delivery line. Details of the construction and mounting of the reel are clearly shown in one of the drawings.

The protection thus given the various shop buildings and cars in the yard warrants the expenditure necessary to apply the pumps as a switch engine so equipped can quickly reach a fire and becomes a very effective means of reducing fire losses.

Master Boiler Makers' Convention

Over 700 Members Were Present; Report on Drilling Staybolts, Addresses and Other Business

THE Master Boiler Makers' Association held its eleventh convention at the Olympic Theater, Chicago, May 26 to 29, with over 700 members in attendance. An address was made by Frank McManamy, assistant director, Division of Operation, U. S. R. A. Mr. McManamy spoke of the benefit to be derived from a full discussion of new methods and practices at conventions and mentioned particularly the importance of some of the topics which had been made the subject of reports to be presented at this meeting. In closing he dwelt on the necessity for thorough workmanship in locomotive repairs.

D. A. Lucas (Prince Mfg. Co.)
President

J. B. Tate (Penn. R. R.)
First Vice-President

C. P. Patrick (Erie)
Second Vice-President

T. Lewis (L. V.)
Third Vice-President

T. P. Madden (Mo. Pac.)
Fourth Vice-President

Following Mr. McManamy's talk, D. A. Lucas, president of the association, delivered the presidential address. Addresses were made by A. G. Pack, chief inspector of locomotive boilers; R. H. Aishton, regional director of the Northwestern Region, and H. T. Bentley, superintendent motive power and machinery, Chicago & North Western.

ADDRESS OF H. T. BENTLEY

Under present conditions a first-class boilermaker is a specialist and no hit-and-miss methods will do; with steam pressure from 150 to 240 lb. per sq. in., the boiler must be maintained in good condition to do its work safely and efficiently, and with the labor-saving devices now in use at all up-to-date shops there is no excuse for not having it in that condition. With the good wages now paid there should be a corresponding increase in output, so that the government we are all working for will feel that the increase given the employees is appreciated and the results obtained justify the action taken.

The railroads before the war had a number of plans to improve the service, and probably nothing in the motive power department would give greater returns for the money expended than the providing of water purifying and hot water washout plants. All of these plans were temporarily side-tracked during the strenuous times just past. Now that the war is over, these plans should again be given early and favorable consideration and plants installed where it is known that the expense is justified. With good water and freedom from boiler troubles, failures on the road and maintenance costs are low; with poor water the conditions are changed, resulting in high maintenance costs, inferior service on the road, delays at the roundhouse and a disgruntled superintendent. Money must be spent either to purify the water and keep the engine in service or to make frequent repairs and have occasional failures. In my judgment it is far better to furnish good water and obtain good service instead of poor water and poor service.

One important thing that foremen should get together on is the balancing of work so that necessary boiler and machinery repairs will be made while the engine is out of service to enable a locomotive to go out of the shops and perform a proper period of service without trouble from boiler or machinery. On several occasions it has come to my attention that an engine will be out of service, having the wheels dropped and quite heavy machinery repairs and a few weeks afterwards the same engine will come back to shop for new flues or side sheets and, of course, nothing will be necessary on other parts of the locomotive. In this case the engine is out of service for two periods close together, whereas all of the work could and should have been done at the same time.

The electric welding of two-inch boiler flues in back flue sheet is something that interests me. We have tried it and find that with good water the flues don't leak or bridges crack and therefore welding is unnecessary; with poor water it is very desirable to do this if you do not run into other troubles. We bought 26 new boilers some time ago and specified that the two-inch flues should be welded, and after three or four months service the flue bridges cracked and new flue sheets had to be applied. The welding of superheater flues appears justifiable by reducing troubles on account of leakage and overcoming engine failures, and if this is so successful, I cannot see why the welding of small flues would not be a good thing.

The federal locomotive inspection department has been responsible for a great improvement in the condition of locomotive boilers, etc., and a closer co-operation on the part of the mechanical officers with the inspectors will bring about a still greater improvement.

APPLICATION AND DRILLING OF TELL TALE HOLES

The best method in all cases to apply tell tale holes is before the staybolt is applied. This may be done on an automatic drilling machine or a small drill press rigged up for this in the shop. The most economical and best method to cut the bolts off is with the oxy-acetylene torch, in this way not disturbing the bolt in the sheet as is done with a hammer or a chisel bar, or staybolt nippers.

It is the practice in one shop to punch the tell tale hole in the staybolt on a forging machine in the blacksmith shop. This is done in one heat in two operations; first a rather blunt tool is used which punches a hole about 3/8 in. in diameter to about 5/16 in. depth, which acts as a countersink on the end of the bolt; the bolt is then raised in the die and a 7/32 in. hole 1½ in. deep is punched. It is our opinion that this is the best method known of applying tell tale holes in staybolts. If the dies are properly made the result will be a bolt of proper size with the tell tale hole in the center.

For drilling tell tale holes we use a 7/32 in. high speed twist drill both in new bolts and in opening up old tell tale holes. However, where holes are forged as above mentioned, we do not find it necessary on new bolts to use a drill as the holes can be very easily opened with a taper pin. The lubricant used is composed of soft soap and water, both for drilling and for opening up new bolts.

The report was signed by Louis R. Porter (Soo Line), chairman, A. N. Lucas (C. M. & St. P.) and Barnard Wulle (Big Four).

OTHER BUSINESS

Reports on Application of Brick Arches to Fireboxes: Design of Ash Pan and Draft Appliances and Bracing of Locomotive Tenders were submitted by committees and will appear in a later issue.

The products of 47 different companies were exhibited at the convention.

There was an attendance of 745 members at the convention, and during the convention 198 applications for membership were received.

The following officers were elected for the ensuing year: President, John B. Tate, foreman boilermaker, Pennsylvania Railroad, Altoona, Pa.; first vice-president, Charles P. Patrick, general boiler inspector, Erie Railroad, Cleveland, O.; second vice-president, Thomas Lewis, general boiler inspector, Lehigh Valley, Sayre, Pa.; third vice-president, Thomas P. Madden, general boiler inspector, Missouri Pacific, St. Louis, Mo.; fourth vice-president, Edward W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul, Dubuque, Iowa; fifth vice-president, Frank Gray, foreman boilermaker, Chicago & Alton, Bloomington, Ill.; treasurer, William H. Laughridge, foreman boilermaker, Hocking Valley, Columbus, O.; secretary, Harry D. Vought, New York City. The following were elected members of the executive board to serve for three years: E. J. Reardon, district inspector, Interstate Commerce Commission, Chicago; Thomas F. Powers, foreman boilermaker, Chicago & North Western, Oak Park, Ill.; Harry F. Weldin, foreman boilermaker, Pennsylvania Railroad, Philadelphia. Henry F. Wandberg, foreman boilermaker, Chicago, Milwaukee & St. Paul, Minneapolis, Minn., was elected to the executive board for one year.

E. W. Young (C. M. & St. P.)
Fifth Vice-President

H. D. Vought,
Secretary

F. Gray (C. & A.)
Treasurer

Locomotive Repair Shop Output

A Proposed Formula for Measuring and Comparing the Cost of Repairs in Relation to the Output

BY HENRY GARDNER

There have been a great many formulae proposed for measuring the output of a locomotive repair shop or for the purpose of comparing the output of two or more shops. All are more or less in error and no one of them will give figures which can be relied upon to state positively which one of two shops delivered the largest output per man or indicated the most able and successful management.

The old method of equating or listing repairs by classes is very unreliable. A Class 3 repair in one shop may cost twice as much as in another, and the amount of work done will vary in proportion. When you compare two shops on this basis, the superintendent having the smaller output will at once start to tell you of the superheaters, stokers, valve gears, etc., that he put on and the other man did not. He will also show you a list of flue sheets, side sheets, etc., greatly in excess of similar work done by the competing shop. The size of the power, weight, and wheel arrangement and cost of repairs will then be brought into the argument as factors rightly having a decided bearing upon the exact quantity of work performed in the shop. Finally the argument is dropped just where it started; no definite and satisfactory conclusion could be made.

It has been generally conceded that the cost of repairs to a locomotive varied almost in direct proportion to its weight. Ernest Cordeal in an article describing a method for determining shop output by means of cost units (Engineering Magazine, May, 1915), states that "The cost of identical repairs will usually vary in direct proportion to the total weight." This may be correct if parts of engines or jobs are considered. For example, the cost of repairs to main rods might run higher on a large engine than a small one, but if the entire repair is considered the cost per ton weight of engine will be found to vary, in most shops, in some inverse proportion to the weight. Assuming that costs of repairs vary directly as total weight of engine, the tonnage repaired was added up and this figure divided into the total cost to get the cost per ton. The result was arbitrarily called a "work unit," and the lower the unit the better the showing for the shop considered.

Another method consisted of adding up these units to indicate quantity of output delivered and then comparing the totals. It amounts to the same thing whether we add up the costs per ton of all engines delivered or call the average cost per ton a "unit" and multiply this unit by all the tonnage delivered. The final result simply reduces itself to a cost per ton comparison of output.

The simple output formula described above was found to be closer to facts than the older methods and might in some cases fairly measure the shop rating. Weight is an important element in output and total labor and material costs vary almost directly as the quantity of work performed. A large engine, as a whole, would usually cost more to repair than a small one, provided exactly similar work was performed on each, but the cost per ton for the large engine (Mallets and engines under 50 tons total weight excepted) is found to be less than for the small one.

Pursuing this course further the writer has developed an arbitrary formula which closely represents the quantity of shop output. This formula gives no rational figures that can be used for statistical or accounting purposes, but it has a legitimate and proper value when used exclusively for making comparisons. Bearing in mind that the cost per ton of the majority of repairs varies inversely as the total weight, it is apparent that we must compensate in some manner for this variation. In other words we must devise a formula which will give proper credit for the Mallets and small power. Such a formula would read as follows:

$$\text{Total cost per equivalent work unit} = \frac{\text{Total labor and material cost}}{\text{Total work units} \times \text{a constant}}$$

Referring now to Fig. 1, a curve is shown which approximates a parabola. Plotting this curve for a large number of repairs developed the fact, for the repair shop considered, that the cost of repairs per ton varied in inverse ratio to the total weight for engines weighing between 50 and 180 tons. The total labor and material cost to repair an engine weighing 100 tons will average $34 a ton (four classes of repairs averaged together), but an engine weighing 50 tons will average $60 a ton. This unexpected result may be due partly to the tendency on most roads to run up the mileage between shoppings on small branch line engines and switching power.

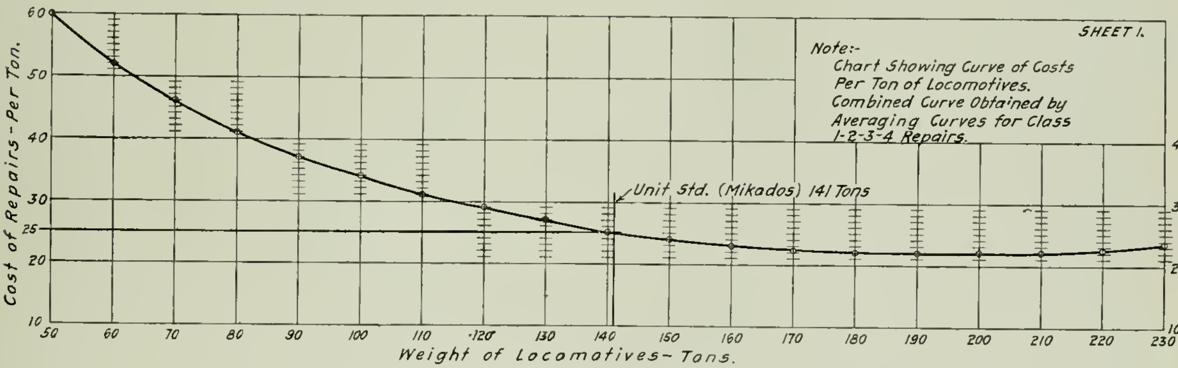


Fig. 1—Cost of Repairs Per Locomotive-Ton Curve

It is also the case that patterns, castings and blue prints for small, out-of-date engines are not as easily located as for the larger modern power. There is also considerable work to be done on small boilers and fireboxes in order to meet present government regulations.

In the formula given above the total cost per equivalent work unit is our output measure. This is derived by dividing the actual labor and material cost of the repairs (for one month or any period desired) by the work (cost) units multiplied by a constant. As the total cost of the repairs increases in the numerator of the fraction the total work units, to a degree, will correspondingly increase in the denominator, since the work units result primarily from the money expended. One work unit is arbitrarily taken as $20 labor and material cost in order to make the quotient come out in easily comparable whole numbers.

It is evident that this formula is fair and logical for all cases. When the numerator gets credit the denominator will also get a varying amount of credit. But since the work units are fixed and based upon averages, and the total cost is an actual quantity, any extraordinary increase in expenses due to overtime or improper management will be reflected in the actual total cost figures. This increase will correspondingly raise the quotient and indicate the abnormal conditions present. The converse of this is of course equally true.

The constant used in the formula needs some explanation. Referring again to the curve (Fig. 1) we find that an engine weighing 100 tons will cost $34 per ton, and an engine weighing 141 tons will cost $25 per ton. It is now evident that to give the lighter 100-ton engine the proper credit for its greater cost per ton we must multiply the work units for that engine by 34÷25, or 1.4. It is through this constant that the tonnage of output becomes a factor.

By using the formula we are now able to give shops turning out a large proportion of Mallets or small old-fashioned power due credit for the quantity of work performed.

Substituting concrete values in this formula we will have, for a 100-ton engine, Class 3 repairs:

$$\frac{\$4,000}{(120 + 60)\ 1.4} = \$16\ (\$15.87\ \text{actual})\ \text{cost per equivalent work unit.}$$

Where 4,000 = actual labor and material cost from shop accounts
120 = standard work units allowed for straight Class 3 repairs
60 = work units allowed for betterments as per list (Fig. 3)
1.4 = constant from the curve (Fig. 1)

It may be explained that the standard Mikado locomotive and some heavy Pacifics weighing about 141 tons were taken as unity for the constant scale. The work units for 141-ton engines will then be multiplied by constant 1.0 and the equivalent will not differ from the actual. This weight was chosen for starting the scale for the reason that engines of these types represent a large percentage of the power repaired and cost figures covering repairs to such engines were found to be most uniform and reliable. The work units are now compensated for the variation of cost of repairs with weight of engine in exactly the same manner as steam tables show the equivalent evaporation from and at 212 degrees, the boiling point of water.

An examination of Fig. 3 shows how the extraordinary work and betterments applied to the regular repairs are listed under 36 items. It was thought best to include small flues and radial stays in this list since credit could then be adjusted for full or partial sets if desired. Each item is given a current cost unit figure based upon actual average costs, including overhead, covering all classes of power for a considerable period. Dividing these costs by 20 gives in each case the number of straight cost units expended for each item. The units here shown were adopted in 1917

UNIT OUTPUT SHEET ____________ SHOPS ________ 1919 SHEET 3

	Class of Work	Std. Units																			
		Eng. No.	1431	1968	4044	1246	1447	1530	2016	2145	2801	2811	2869	4097		1265	1653	1803	4064	2374	M
		Repair Class	1H	18H	1	18	2H	2B	2H2	2	2H	2	2	2H		3B	3	3	3	4F	4F
		Wt. Tons	106	91	141	72	106	74	86	138	110	110	110	141		73	84	91	141	97	
1	Course Sheet	8																			
2	Roof Sheet	20																			
3	Throat Sheet	10																			
4	Side Sheet-Outside	11																			
5	Wrapper Sh-Inside Crown and Sides	28																			
6	Back Head	17																			
7	Front Flue Sheet	4	X	X			X		X		X	X		X							
8	Dome Sheet	3																			
9	Crown Sheet	16																			
10	Back Flue Sheet	7							X												
11	Side Sheet-Inside	10						X				X	X								
12	Door Sheet	9																			
13	Set Radials	8																			
14	Set Flues-Plain	8																		X	
15	Frank. Auto. Fire Door	5																			
16	Smokebox Sheet	2																			
17	Each New Cylinder	14																			
18	Univ. Steam Chest	32							X												
19	New Wh. Center	3	X				X														
20	New Driv. Axle	3	X				X		X		X							X			
21	Set New Tires	18	X	X	X		X	X		X	X				X		X	X		X	
22	Baker Valve Gear	50							X												
23	Power Rev. Gear	14																			
24	Chambers Throttle	6																			
25	Each Frame Rep'd	3		X		X		X								X					
26	New Frames-Two	40							X												
27	New Wood Cab	6																			
28	New Steel Cab	11								X											
29	New Superheater	75	X	X			X		X		X			X	X						
30	Set Flues-Super.	2																			
31	Add Air Pump	8																			
32	New Stoker	78																			
33	New Tend. Frame 12A-Steel	32	X	X			X														
34	New Tend. Frame-Wood	3				X		X									X				
35	Steel Bumper	5																			
36	Boy. Speed Recorder	5																			
37																					
	Total Units																				

Fig. 2—Tabulation of Repairs by Individual Item

and will not apply to present day rates, as costs will necessarily vary from year to year and need periodical revision.

Fig. 2 indicates how these cost items are checked off for a whole month's output for the shop under discussion. Fig. 4 shows how the data from Fig. 2 is compiled and made ready for applying to the output formula. The last column gives the solution or, "cost per equivalent work unit." For

LOCOMOTIVE COSTS — SHEET 2

NO	CLASS OF WORK	LABOR	MATERIAL	TOTAL	UNITS	REMARKS
1	COURSE SHEET				8	ALL COSTS
2	ROOF SHEET				20	INCLUDE COSTS IN ALL DEPARTMENTS
3	THROAT SHEET				10	SCRAP CREDIT &
4	SIDE SHEET - BOILER				11	OVERHEAD
5	WRAPPER SHEET - INSIDE CROWN & SIDES - 1 PIECE				28	VALUE 1 UNIT -
6	BACK HEAD				17	$20.00 LABOR & MAT'L
7	FRONT FLUE SHEET				4	
8	DOME SHEET				3	
9	CROWN SHEET				16	
10	BACK FLUE SHEET				7	
11	SIDE SHEET - FIREBOX				10	
12	DOOR SHEET				9	
13	FULL SET RADIALS				8	
14	SET OF FLUES - PLAIN				8	REPAIRED
15	FRANKLIN AUTOMATIC FIREDOOR				5	
16	SMOKE BOX SHEET				2	
17	EACH NEW CYLINDER				14	
18	UNIVERSAL STEAM CHEST				32	
19	EACH NEW WHEELCENTER				5	
20	EACH NEW DRIVINGAXLE				3	
21	SET OF NEW TIRES				18	
22	BAKER VALVE GEAR				50	
23	POWER REVERSE GEAR				14	
24	CHAMBERS THROTTLE				6	
25	EACH FRAME REPAIRED				3	
26	NEW FRAMES TWO				40	
27	NEW WOOD CAB				6	
28	NEW STEEL CAB				11	
29	NEW SUPERHEATER				75	SUPERHEATER FLUES INCL.
30	SET OF FLUES - SUPERHEATER				2	REPAIRED
31	ADDITIONAL AIR PUMP				6	
32	NEW STOKER				78	
33	NEW TENDER FRAME - 12A - STEEL				32	
34	NEW TENDER FRAME - WOOD				3	
35	STEEL BUMPER				5	
36	BOYER SPEED RECORDER				5	
37						
38						

Fig. 3—Unit Value of Repairs

a final decision this column should be averaged by periods or classes as desired. Fig. 5 is used for summarizing cost units by classes of repairs and by months. Fig. 6 which shows graphically how the labor and material costs vary,

CLASSIFIED LOCOMOTIVE REPAIRS — SHEET 4

_____ SHOP. _____ 1919.

	LOCO. NO.	WORK UNITS	CONSTANT	EQUIVALENT WORK UNITS	COST LABOR	COST MATERIAL	COST TOTAL	COST PER EQUIV. WK. UNIT	REMARKS
CLASS 1	1431	307	1.3	400	1407	2318	3725	9.3	
	1968	278	1.7	473	1598	1926	3524	7.5	
	4044	168	1.0	168	2268	2628	4896	29.1	
	1246	156	2.1	328	1523	2298	3821	11.6	
CLASS 2	1447	266	1.3	347	1476	1104	2580	7.4	
	1530	149	2.1	313	1577	933	2510	8.0	
	2016	315	1.7	336	2601	2818	5419	10.1	
	2145	149	1.0	149	2243	3281	3524	23.6	
CLASS 3	1265	133	2.1	279	1613	1131	2744	9.8	
	1653	151	1.9	287	1481	1298	2779	9.7	
	1803	151	1.7	257	1493	1553	3046	11.8	
	4064	130	1.0	130	1574	1261	2035	15.6	
CLASS 4	2374	108	1.5	162	1483	1485	2968	18.3	
	Motor	25	1.0	25	132	320	452	18.1	
CLASS 5									

Fig. 4—As Classified from Sheet 3

when applied to the 36 items shown on Fig. 3, is of interest but has no particular value for applying the formula.

This procedure involves a considerable amount of work and a familiarity with shop repair records, but there is no known short and easy way to accurately compare shop output if a reliable decision is required.

It may be well to state that repair costs vary with different shops, and if a nicer comparison is desired, separate cost units can be worked up for each shop. This should of course be done if the above methods are employed to compare the relative efficiency of shops on different roads, as different operating methods and facilities will vary the costs considerably. Another refinement could be made by constructing separate cost per ton curves for each class of repairs instead of using the composite curve shown in this article. The repairs should then be separated by classes and the constants obtained from the corresponding curve for that class. Separate curves indicate that Class 1 repairs cost more for light tonnage than other classes, Class 2 and 3 repairs follow the composite curve closely and the

CLASSIFIED LOCOMOTIVE REPAIR COSTS — SHEET 5.

_____ SHOP		COST OF REPAIRS LABOR	COST OF REPAIRS MATERIAL	COST OF REPAIRS TOTAL	TOTAL EQUIV. WORK UNITS	COST PER UNIT ACTUAL	COST PER UNIT STANDARD	REMARKS
JANUARY	CLASS 1							
	2							
	3							
	4							
	TOTAL							
FEBRUARY	CLASS 1							
	2							
	3							
	4							
	TOTAL							
MARCH	CLASS 1							
	2							
	3							
	4							
	TOTAL							

Fig. 5—Monthly Summary Sheet

Class 4 repair curve shows a more nearly uniform cost for all tonnage, as would be expected. These repair classes should conform to the standards adopted by the United States Railroad Administration.

The formula and principles described in this article have been used for checking the relative output of several shops and the results have substantiated the opinions of those competent to judge by other methods combined with experience. This work could be drawn much finer, and instead of using only 36 betterment items, 100 could be taken,

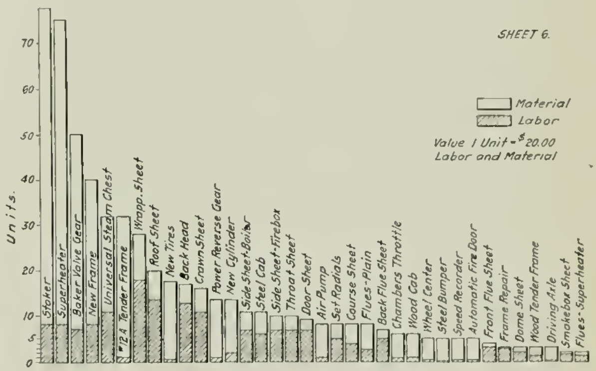


Fig. 6—Comparative Cost

or all the work performed on the engine could be itemized directly from service and material cards, but it is felt that the method shown is simple and inexpensive and serves the purpose. Moreover it is questionable whether service and material cards as made out in the majority of railroad shops are as accurate a guide as the averages here obtained. Using this same relative cost unit data for all shops puts all on the same basis and no one shop could claim that service and material cards or clerical compilations were in error.

This subject is important and one which has never yet been satisfactorily settled. What is needed is a measure that will equal the foot rule when applied to the output of locomotive repair shops, and until such a measure is accurately constructed no one is in a position to state positively that one shop is well or poorly managed or that the output is greater or less when making comparisons with other shops.

Railroad Administration News

About 19,000 Standard Cars Stored Awaiting Acceptance by the Roads to Which They Are Assigned

APPROVAL has been given to issuance of Pullman annual passes to general chairmen of shop crafts, to be made good on railroad or railroads over which such general chairmen have jurisdiction, and also on such foreign lines as they may hold railroad transportation over, which has been furnished to them for the purpose of enabling them to make short cuts between points on the lines over which they have jurisdiction.

Application for these passes should be made by the federal managers to the director, Division of Operation, at Washington.

385,000 surplus freight cars

The net surplus of freight cars on May 1 was 385,447, including nearly 20,000 on Canadian roads, according to reports compiled by the Car Service Section. This represents a larger number of idle cars than has been recorded at any time since April, 1908, except on March 1 and April 1 of this year. On March 1 the net surplus stood at 473,080 and on April 1 it was 446,685, so there was a reduction during April of 61,000.

Punitive overtime up to director general

The question as to whether the train service employees are to be allowed a punitive rate for overtime is again up to Director General Hines for decision. The brotherhoods have reiterated since the Railroad Administration has been in control their demands for time and a half for overtime which was waived during the negotiations which preceded the enactment of the Adamson law. When Supplements 15 and 16 to General Order No. 27 were issued by Director General Hines in April the matter was referred to Board of Adjustment No. 1 for a report. The board, however, was not able to agree, and has submitted two separate reports, one of which presumably represents the views of the brotherhood representatives on the board, while the other represents the views of the managers of the roads. Before deciding, Director General Hines has ordered an investigation as to the cost of paying punitive overtime in road service.

Mechanical officers instructed to report on June conventions

Frank McManamy, assistant director of the Division of Operation, has addressed the following to the regional directors, asking that mechanical officers be instructed to make written reports regarding their observations at the June conventions:

"The convention of Section 3, Mechanical, American Railroad Association, which is composed of the Master Car Builders' Association and American Railway Master Mechanics' Association, will be held at Atlantic City, June 18 to 25.

"It is desired that the representative members from the different railroads attend, as far as possible, and that other mechanical department officials who are members be permitted to attend for at least a portion of the time, where they can be spared from their regular duties without adversely affecting the service. It is anticipated that there will be on exhibition the most complete collection of mechanical appliances that has ever been exhibited at one of these conventions, and a study of it will be of substantial value to the mechanical department officers who are in attendance.

"In order to obtain the greatest possible amount of benefit from this convention, it is desired that each member present below the rank of superintendent of motive power shall, on his return from the convention, make a written report to the superintendent of motive power, relative to the new devices which he inspected at the convention, or ideas which he obtained from the discussions which can be applied with profit to the work under his direction.

"The superintendent of motive power will make a digest of the various subjects presented in this way, so that those which can be profitably adopted may be given consideration, sending a copy of it to the assistant director, Division of Operation, in charge of the mechanical department, for the use of the Committee on Standards for locomotives and cars.

"Will you please issue the necessary instructions?"

Comparison of car and locomotive repairs in 1917 and 1918

The following table showing comparisons regarding car and locomotive repairs in 1918 and 1917 was included in a general statement filed by Director General Hines with the Senate Committee on Interstate Commerce, showing the expenses of the Railroad Administration:

Repairs to Locomotives and Cars Combined, 12 Months, January to December, 1917-1918

	1918	1917
Average number of serviceable freight locomotives	30,824	30,378
Average number freight locomotives in or awaiting shop	4,624	4,286
Per cent freight locomotives in or awaiting shop	15.0	14.8
Average number freight cars in service	2,430,786	2,363,309
Average number freight cars in or awaiting shop	138,989	133,252
Per cent of freight cars in or awaiting shop	5.7	5.6
Total number of locomotives receiving repairs requiring more than 24 hours	235,522	193,924

Comparison of Freight Cars Repaired by Railroads Under Federal Control, 1917 and 1918

	Light	Heavy	Total
(1) Number of freight cars repaired by 133 Class I railroads and 22 Class II railroads, showing separation between light and heavy repairs:			
1917	29,207,081	1,941,380	31,148,461
1918	27,650,214	2,005,926	29,656,140
Increase, 1918 over 1917	....	64,546	....
Decrease, 1918 over 1917	1,556,867	....	1,492,321
(2) Number of freight cars repaired by 6 Class I railroads that were unable to give complete separation between light and heavy repairs:			
1917			1,112,966
1918			1,154,085
Increase, 1918 over 1917			41,119
(3) Total number of freight cars repaired by 161 railroads, representing ownership of 2,357,208 cars:			
1917			32,261,427
1918			30,810,225
Total decrease, 1918 over 1917			1,451,202

(*a*) Referring to item (1), showing decrease of 1,556,867 light repairs, 1918 over 1917, with an increase of 64,546 heavy repairs: The reduction in light repairs is due to reporting light running repairs, requiring less than one 1-man hour to repair, in 1917, which were not permitted reported in 1918.

(*b*) Item (2) shows substantial increase, 1918 over 1917.

(*c*) Item (3). Explanation for total decrease, 1918 over 1917, is given in paragraph (*a*).

Allocation of equipment

Of the 100,000 freight cars ordered by the Railroad Administration in 1918, 44,542 had been built up to April 30 and 92,750 had been assigned to various companies, but only 25,570 had been accepted, while 18,972 of the cars already built were in storage at the car-building plants. The numbers of the various types are shown in the table.

Numbers and Types of Cars Built by the Railroad Administration Not Yet Accepted by the Railroads

Type of cars	Number of cars
40 ton double sheath box cars	3,702
50 ton single sheath box cars	1,169
50 ton composite gondolas	6,043
55 ton steel hopper	8,057
70 ton low side gondolas	1
Total	18,972

Of the 1,930 locomotives ordered, all but 41 had been assigned, but all the assignments had not been accepted. The locomotives have been accepted as fast as they have been built, but various companies have objected to the assignments just as they have to the cars. Some of the objections are based on the inability to finance the equipment, some on the statement that the cars or engines are not needed, and some are based on the types, although the Railroad Administration has allowed the roads to exchange one type for another where it can be done before the builders have progressed too far with the building or the ordering of materials to make the change.

The circulars sent out by the regional directors asking for information as to the number and types of locomotives that will be required and whether the corporations will be willing to purchase locomotives of their own standards represent an effort to place some of the unaccepted locomotives, but it will not be possible to substitute individual or "made-to-order" designs for the standard types in many instances because the work on the parts for the standard types has been so far advanced.

Plans for the creation of an equipment trust to finance both the cars and locomotives by a single issue of equipment trust obligations amounting to approximately $400,000,000, instead of having individual securities issued by each of the roads, are under consideration by the Association of Railway Executives and the Railroad Administration.

COSTS OF TRAIN AND LOCOMOTIVE SERVICE

A monthly report is being compiled by the Operating Statistics Section of the Railroad Administration which shows the itemized costs of locomotive service per locomotive mile, and train service per train and 1,000 gross ton miles. The figures for February and March, 1919, compared with the same months a year ago are shown in the table. No comparisons are made with last year on the gross ton mile basis.

The comparisons with last year are disturbed to some extent by the factor of back pay being included in this year's figures, while last year's figures do not include the increases in wages which became effective later in the year. Most of the figures for March, however, show decreases as compared with February.

NUMBER AND COMPENSATION OF EMPLOYEES

The January, 1919, pay roll of the Class I railroads under federal control was $230,800,589 for 1,848,774 employees, as compared with $153,039,988 for 1,703,748 employees in December, 1917, according to a statement compiled by the Operating Statistics Section, which shows the effect of the wage increases during 1918 as between the different classes of railway employees, together with the numbers, the days and hours worked, the compensation per day and per hour, and the percentage of change in the unit compensation for each of the 68 classes prescribed by the Interstate Commerce Commission. The average increase in unit compensation was 48 per cent, the range being from a 20 per cent reduction for general officers receiving $3,000 per annum and upwards, up to 98 per cent increase for structural iron workers and 99 per cent for "other yard employees."

The increase in the number of employees was 145,026 or 8.5 per cent and the average compensation per employee in January was about $125, as compared with about $90 in December, 1917. This would amount to an average of $1,500 per year, as compared with an average for the year 1917 of $1,004.

COSTS OF TRAIN AND LOCOMOTIVE SERVICE

	February, 1919	February, 1918	March, 1919	March, 1918
Cost of locomotive service per locomotive mile	120.7	106.3	119.2	100.1
Locomotive repairs	40.2	31.5	40.1	30.7
Enginehouse expenses	10.4	7.4	10.2	6.7
Train enginemen	18.8	20.3	18.8	18.8
Locomotive fuel	47.3	43.9	46.3	41.0
Other locomotive supplies	4.0	3.2	3.8	2.9
Cost of train service per train mile	169.3	155.0	167.5	145.1
Locomotive repairs / Enginehouse expenses	57.7	45.2	57.1	43.4
Locomotive fuel	54 0	51.1	52.6	47.6
Other locomotive supplies	4.6	3.7	4.4	3.3
Train enginemen	21.5	23.6	21.3	21.8
Trainmen	25.1	26.6	25.6	24.4
Train supplies and expenses	6.5	4.8	6.5	4.6
Cost of train service per 1,000 gross ton miles	126.5	....	119.5	....
Locomotive repairs / Enginehouse expenses	43.1	....	40.8	....
Locomotive fuel	40.3	....	37.5	....
Other locomotive supplies	3.4	....	3.1	....
Enginemen and trainmen	34.8	....	33.5	....
Train supplies and expenses	4.8	....	4.6	....

The largest increases in the number of employees are shown in the mechanical department. A considerable reduction is shown in the number of train employees, attributable to the decreased volume of traffic.

A comparison of the number of employees and their compensation in December, 1917, and January, 1918, is presented in the table for the various classes of mechanical department employees and the men in the engine service.

ORDERS OF REGIONAL DIRECTORS

Superheaters.—The Eastern regional director, by circular 500-1-97A728, authorizes the application of superheaters to locomotives where all of the needed material is already on hand. The corporations must be consulted, but if material is on hand such consultation need not cause delay.

Record of Work at Enginehouses.—The Eastern regional director, by circular 1801-127A748, sends to federal mana-

NUMBER AND COMPENSATION OF EMPLOYEES IN OR ASSOCIATED WITH THE MECHANICAL DEPARTMENT (MONTH OF JANUARY, 1919, COMPARED WITH MONTH OF DECEMBER, 1917—CLASS I ROADS UNDER FEDERAL CONTROL)

Class of employee	Number of employees		Compensation: Per day		Compensation: Per hour		Per cent change in unit compensation
	Jan., 1919	Dec., 1917	Jan., 1919	Dec., 1917	Jan., 1919	Dec., 1917	
General foremen—M. E. department	1,745	1,665	8.31	5.00	....	....	66
Gang and other foremen—M. E. department	21,399	18,429	6.77	4.23	....	....	60
Machinists	54,382	42,973	....	....	.719	.509	41
Boiler makers	16,960	13,469	....	....	.713	.504	42
Blacksmiths	9,925	8,369	.. .	....	.707	.494	43
Carpenters (includes other departments)	56,057	50,848	....	....	.579	.350	65
Painters and upholsterers (includes other departments)	11,064	9,878	....	....	.613	.382	60
Electricians	12,061	9,894	5.38	3.22	....	....	67
Air-brake men	7,328	5,846	....	....	.604	.359	68
Car inspectors	24,902	20,763	....	....	.597	.323	85
Car repairers	81,799	66,443	....	....	.568	.366	55
Other skilled laborers (includes other departments)	57,674	55,201	....	....	.624	.374	67
Mechanics' helpers and apprentices	110,870	92,018	....	....	.471	.296	59
Enginehouse men	71,066	60,439	....	..	.423	.242	75
Other unskilled laborers (includes all departments)	122,881	104,050	....	....	.413	.246	68
Hostlers	9,908	8,493	....	....	.506	.329	54
Yard engineers and motormen	19,800	20,355	....	....	.688	.541	27
Yard firemen and helpers	20,694	20,821	....	....	.485	.340	43
Road freight engineers and motormen	31,974	32,923	....	....	.825	.707	17
Road freight firemen and helpers	34,409	35,549	....	....	.616	.456	35
Road passenger engineers and motormen	11,810	12,826	....	....	.987	.898	10
Road passenger firemen and helpers	11,622	12,433	....	....	.694	.559	24

gers revised instructions for reporting, monthly, the number of man hours worked at enginehouses. This report goes to Frank McManamy, Washington.

Report on Reclamation of Materials.—The Northwestern Regional Purchasing Committee, in supplement 7 to circular 10, gives a list of items of material being reclaimed by various roads in this region. The list is long and detailed, containing about 800 items.

Preparation of Box Cars for Grain.—The Central Western regional director in a letter dated April 17 calls for immediate attention to the preparation of box cars for grain, and the providing of well-adapted temporary grain doors where needed.

Annual Passes for Employees.—The Eastern regional director, by circular 2100-9A750, advises federal managers that where an employee requires an annual pass over other than his home road, that pass should include also his transportation over the home road, so that he will carry only one pass for all.

Sanitary Maintenance of Cars, Shops, Etc.—The regional director, Eastern region, by circular 500-97A705 advises federal managers that a committee is at work standardizing the rules for practice in the maintenance of sanitary conditions in cars, shops, offices, etc. The committee wants copies of all such regulations now in effect.

Blacksmiths' Convention.—The regional director, Eastern region, by circular 102-37A745, approves the annual convention of the International Master Blacksmiths' Association, to be held at Chicago, August 19, 20 and 21. Each road will follow its usual practice in regard to allowing blacksmiths to attend.

Tinners' Convention.—The regional director, Eastern region, by circular 102-36A738, and the Northwestern director, by circular 77-1-93, announce approval of the convention which is to be held by the American Railroad Master Tinners', Coppersmiths', and Pipefitters' Association in June. Federal managers exercise their own judgment as to granting leave of absence and giving passes.

Employees' Passes for Conventions.—A. H. Smith, regional director, Eastern region, by circular 2100-37A716, advises federal managers that employees regularly elected as delegates to conventions of their brotherhoods are to be granted free transportation both ways; and ordinarily these passes will be issued at Washington. Trip passes for side trips should be requested and secured through the usual channels.

Violations of Inspection and Safety Appliance Laws.—The Central Western regional director in a letter dated April 19, states that, from the large number of reports which are being made by Interstate Commerce Commission Inspectors to the assistant director of the Division of Operation covering violations of federal inspection and safety appliance laws, it is evident that either the railroad inspectors are not adequately educated or they are careless. A systematic method of handling this matter is advised. Division master mechanics should keep a check upon whether or not the work reported by engineers is being done, and see that reports of violations of rules are followed by suitable discipline. Records should be kept of the violations at each terminal and of the employees responsible for them in each case.

ELECTRIC WELDED PATCHES

BY JOSEPH SMITH

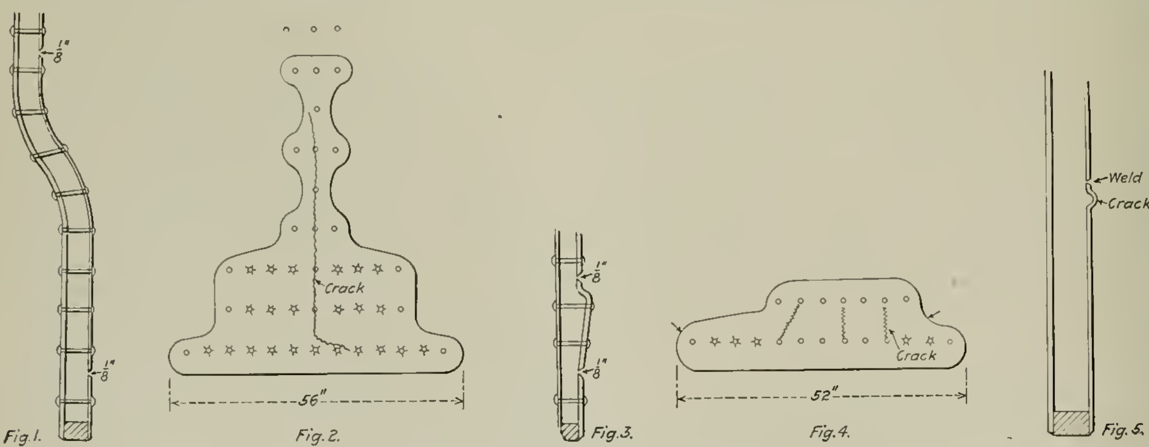
The subject of welding locomotive boilers is one of great importance and various methods of welding patches have been used with success. When patching side sheets the writer has used the electric weld and applied the patches as illustrated.

In the drawing, Fig. 1 shows a patch applied to the right side sheet of a heavy switch engine. The shape of the patch is as shown in Fig. 2 which also shows the crack that had developed in the side sheet.

Figs. 3 and 4 show the shape and application of a patch on the left side sheet of the same engine. This patch was offset 1¼ in. at the top and tapered down to the points indicated by the arrows in Fig. 4. This offset has been found preferable to that shown in Fig. 5, which not only gives trouble at the weld, but frequently cracks in the offset.

The stars in Figs. 2 and 4 indicate staybolt holes which were so badly fire cracked that it was necessary to remove that portion of the side sheet.

Both of these patches were fitted in place with the edges of the patches and side sheets beveled to about 30 deg. with ⅛ in. clearance all around as shown in Figs. 1 and 3. The staybolts were then applied, and the patches electric welded to the side sheets.



Two Electrically Welded Side Sheet Patches

The welding was done by an operator who had had only a few hours' instruction from an experienced welder, and considerable doubt was expressed that this method of patching would prove to be satisfactory. After three months of service, however, there has been no sign of failure or even sweat at the weld.

New And Improved Machine Tools And Shop Equipment

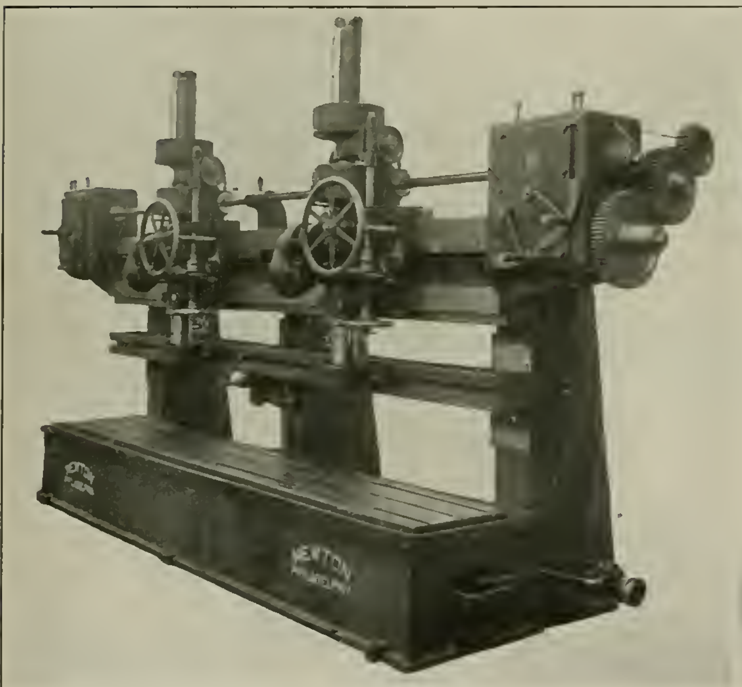
DUPLEX LOCOMOTIVE ROD BORING MACHINE

A DUPLEX locomotive rod boring machine, which was primarily designed for the boring of locomotive rods, but which may be used for the rapid production of parts which require heavy drilling, such as the reaming of cross-heads, etc., has recently been built by the Newton Machine Tool Works, Inc., Philadelphia, Pa. For work of this kind it is, of course, necessary to provide for a strong and rigid support of the spindles and this is particularly true where full advantage is to be taken of the maximum output with high-speed steel tools. The photographs convey some idea of the massiveness of construction which has been necessary to accomplish this.

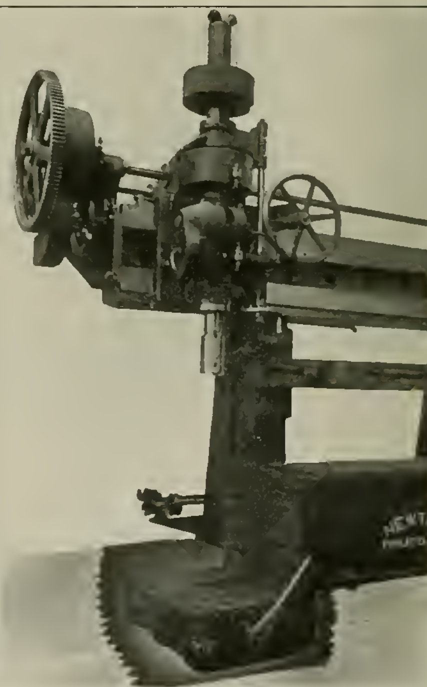
The most novel feature of the new design is the incorporation of the auxiliary side table. This is specially valuable for the reaming of cross-heads. The in-an-out adjustment of this table, supplemented by the longitudinal adjustment of necessity for drilling pilot holes for the boring bars. The kerf made by the cup cutters in no case exceeds $\frac{5}{8}$ in., and the cores are removable solid. The saving in time and power and of wear on the drills is, therefore, an important item. The twin spindles allow a duplication of center distances for similar rods. Two ends of one rod or one end of two rods may be bored at the same time, as may prove most desirable.

One of the photographs shows quite clearly the arrangement of the side table, while the other one shows the machine without the side table but with speed boxes applied for use with constant speed motors, or for single pulley drives. The changes in speed are made by means of sliding sleeves without the removal of the gears; each spindle is under the control of its own speed box, thus making it possible to suit the speed of each tool to the size of the work.

The top of the massive base is finished and slotted to form



Duplex Locomotive Rod Boring Machine With Speed Boxes in Place, But Without Side Table



Showing Application of the Auxiliary or Side Table

the spindle over the table, permits of clamping the work without having to locate it to the actual center. These adjustments also permit of drilling or boring a series of holes at one setting of the work. The T-slots on the vertical face of the adjustable table permit clamping the work in either a horizontal or vertical position, according to the convenience of the operator. The rail is extended to carry the spindle center 18 in. beyond the vertical face of the auxiliary table, thus giving a maximum distance between the spindles of 14 ft. 5 in. The side table is low to allow work of extra height to be placed under the spindle. For instance, the distance from the top of the side table to the spindle end is 50 in. maximum and 34 in. minimum. This corresponds to a maximum distance from the top of the main table to the end of the spindle of 25½ in.

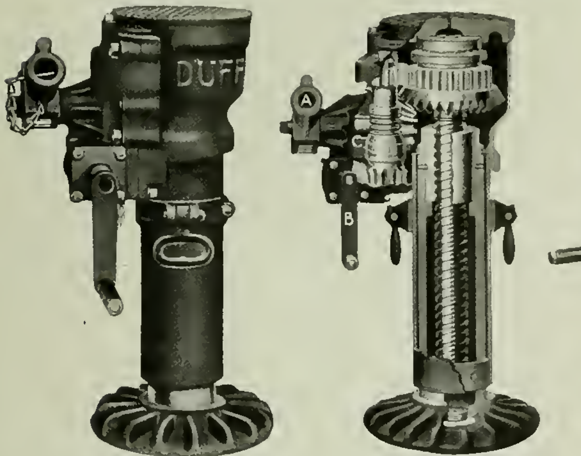
The machine utilizes cup cutters which dispense with the a working surface or table. It is surrounded by an oil pan, cast integral with the base. The rail is supported by the three uprights and is of heavy construction, of box type, braced internally by ribs. The spindle saddle has an angular bearing on the bottom section of the rail, insuring close contact under heavy pressure. The top bearing is square, the adjustment being made by a bronze taper shoe on the top and a gib bolted to the saddle on the rear. The saddle may be securely held in any predetermined position on the rail and is adjustable crosswise by means of a pinion. the end of which is squared to fit the removable ratchet.

The spindle revolves in bushed bearings in the sleeve and has a Morse taper, and drift and retaining key slots. The spindles are 4 in. in diameter with a diameter of spindle nose, outside of 5½ in. The minimum distance between spindle centers is 30½ in. The distance from the center of the spindles to the uprights is 17½ in. Each spindle is driven by a worm and worm wheel, the worm wheel having a bronze ring with teeth of steep lead; the driving worm is of hardened steel with roller thrust bearings. Both the worm and the worm wheel are encased for continual lubrication. The sections of the spindle fitting in the rack sleeve revolve in bronze bushings. The upper end of the spindle and the rack sleeve are encased and protected from dust and dirt by covers which also serve as a support for the counterweight. Thrust of the worm is taken by a bearing cast solid with the saddle.

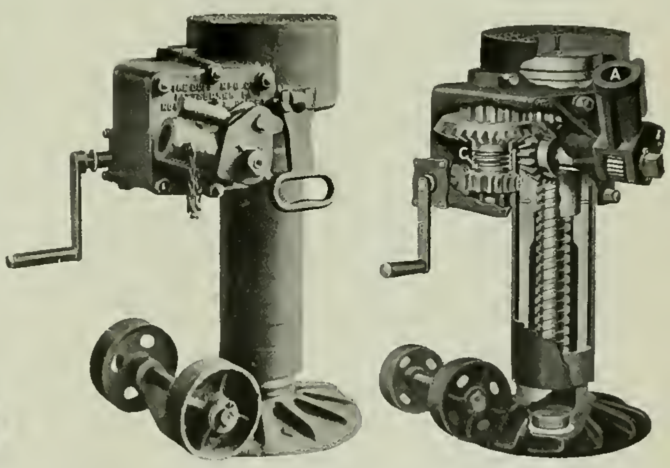
Motion for the feed is provided through spiral gears, one of which is mounted on the spindle sleeve; the other is keyed to the horizontal pull pin shank on which are also mounted four pull pin gears, giving four changes of feed which are transmitted to the rack sleeve by means of a worm and worm wheel. A cone friction clutch permits either power or hand elevation. The saddles have hand adjustment on the rail. The auxiliary or lower support for the spindles has a bearing on each upright; it securely supports the spindles at the lowest possible point when cutting, and is raised and lowered by means of a worm and worm wheel. The work table is 24 in. wide and 13 ft. 6 in. long.

HIGH SPEED BALL BEARING SCREW JACKS

An improved type of high speed ball bearing screw jack has recently been designed by the Duff Manufacturing Company, Pittsburgh, Pa. These jacks are specially adapted for the handling of railway equipment and are made in several sizes of three capacities: 35-ton, 50-ton and 75-ton. The high speed feature is obtained through the use of a large pitch, double-thread screw, and safety is insured by a patented automatic, positive safety clutch. The load is raised by placing a long solid steel bar in the lever socket *A* and operating it up and down, the load being raised on each down stroke. The positive clutch *C* holds the load at all times and prevents the possibility of sinking or dropping under the load. A few easy turns of the handle *B* allows the load to be lowered quickly. Regardless of the speed at which the jack may be descending, the lowering handle may be stopped with absolute safety to within a thousandth of an inch of any desired point. So little effort is required to lower the load that a boy can operate the 75-ton jack with ease. By turning the lowering handle in a reverse direction, it is possible quickly to raise the jack up to the load.



External and Sectional Views of 35-Ton and 50-Ton High Speed Jacks



External and Sectional Views of the 75-Ton High Speed Jacks

The thread of the large double screw is so steep that the jack would run down under its own weight were it not for the positive safety clutch. It is, of course, the combination of the steep thread screw and the positive clutch that provides for speed and safety. The screw is made of special steel and turns in a hard bronze nut, having a tensile strength of 90,000 lb. per inch. The combination of bronze and hard steel materially reduces the friction. The base, consisting of the foot and the stem, is made in one piece of cast steel; the shell is of steel tubing; the bonnet and hood of cast steel, and the gears, clutch, shafts, etc., of open hearth machinery steel with the more important parts heat-treated. The pinion shaft is fitted with a heavy phosphor bronze bearing bushing. The ball bearing in the head consists of two chrome nickel steel discs, hardened and containing large hardened alloy steel balls tested to a crushing strain of 110,000 lb. each.

The design and workmanship are such as to reduce the friction to a minimum. To provide for lubrication the inside of each jack is packed with a semi-fluid grease, in which all of the moving parts revolve. The composition of the grease is such that it is not affected by heat or cold and will not leak. Oiling places are provided for the lubrication of every part which requires lubrication and is not reached by the grease.

These jacks may be fitted with foot lifts for the convenient handling of low loads; the toe lift is cast integral with the shell. The 75-ton jacks, which are specially adapted for heavy locomotive work, may be equipped with wheels, as shown in the illustration, to facilitate handling.

The 75-ton jack is made in three sizes as follows:

26 in. high	12 in. lift	weight 360 lb.
24 in. high	10 in. lift	weight 345 lb.
20 in. high	6 in. lift	weight 315 lb.

The 50-ton capacity jack is made in three sizes as follows:

36 in. high	24 in. lift	weight 270 lb.
26 in. high	14 in. lift	weight 235 lb.
24 in. high	12 in. lift	weight 228 lb.

The 35-ton jack is made in two sizes; one 30 in. high, 17 in. lift, weighing 175 lb.; and the other 26 in. high, 13 in. lift, weighing 163 lb.

TWENTY-ONE INCH VERTICAL DRILLING MACHINE

THE vertical drill shown in the illustration is a modification of the standard machine made by the Weigel Machine Tool Company, Peru, Ind. The regular quick return and power feed with back gears have been replaced by a plain quick return operated by four extra levers mounted in the form of a pilot wheel which provides a powerful hand feed. The control lever operating the friction clutch for starting, and acting as a brake for stopping the drill, is conveniently placed for the operator.

The spindle is driven through a friction type back gear device enclosed in the oil-tight box which is cast as an integral part of the top of the frame. An improved tapping attachment may also be furnished and is placed directly on the spindle.

The standard machine, which is furnished with the friction type back gear contained in a box casting similar to that shown on the top of the frame of the drill illustrated, provides eight feeds for each spindle speed, as indicated by the feed plate attached to the machine, and the same type of lever which is used for starting and stopping the plain hand feed machine is employed on the standard type. A special back gear lever provides means for throwing the gears in and out of mesh. Feeds per revolution of the spindle run from .004 in. to .0432 in., and an automatic stop is provided which can be set to throw out the feed at any predetermined depth.

The plain hand feed machine, as well as the standard power feed machines, are made in 21-in. and 25-in. sizes, and may be arranged for either direct gear motor drive by a 3-hp., 1,500 r.p.m. motor, or for drive by belt. The lower cone pulley is covered by a cast housing and the tight and loose pulleys in the belt drive type have an adjustable cast guard. The mechanical belt shifter, a detail small in itself, contributes to a saving of time.

The base of these machines is heavy and well ribbed underneath. A slot is provided at the front and rear to accommodate a bar for moving and placing the machine when setting it up on a solid floor. The spindle has a 9-in. vertical travel and a No. 4 Morse taper. The column is tubular in section and has an extra large bearing for the table arm, as well as for the sliding head.

The table is 19-in. in diameter and has a traverse of

Vertical Drill With Powerful Hand Feed

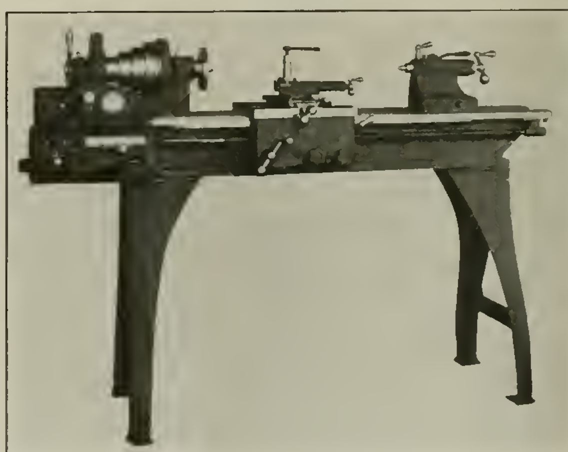
13½ in. on the column. A square table with an oil pan can be furnished instead of the round table. The table is raised and lowered by rack and pinion through a worm gear.

QUICK CHANGE ENGINE LATHE FOR SMALL WORK

THE new 11-in. Star quick change engine lathe in 4, 5, 6 and 7-ft. lengths of beds, has been recently added to the line of tools manufactured by the Seneca Falls Manufacturing Company, Inc., Seneca Falls, N. Y. Because of their wide range for exacting service on light and accurate work they should commend themselves generally to railroad shop tool rooms and testing laboratories.

The smaller size (4 ft.) occupies a space of 27 in. by 64 in.; the largest (7 ft.) requires 27 in. by 100 in. floor space; distances between centers range from 24 in. to 60 in. The actual swing over beds is 12⅛ in. Threads from 6 to 40 per inch may be obtained with a simple, quick change mechanism. By the shifting of a gear on the stud, the range may be increased from 3 to 92 threads per inch, including 11½ per inch, all of which are plainly listed on the index plate on the face of the machine. A special countershaft with three friction pulleys may be furnished to give higher speeds for wood turning.

Details of the construction of these new tool room lathes include a web pattern headstock and a hollow spindle made from carbon crucible steel, accurately ground to size, revolving in ample hand-scraped ring oiling bearings; the nose is threaded part way only to facilitate changing chucks and face plates without damaging the threads and to insure perfect fit. The spindle has a large hole suitable for a draw-in chuck. The cone is locked to the head-gear by an improved



11-Inch Quick Change Engine Lathe

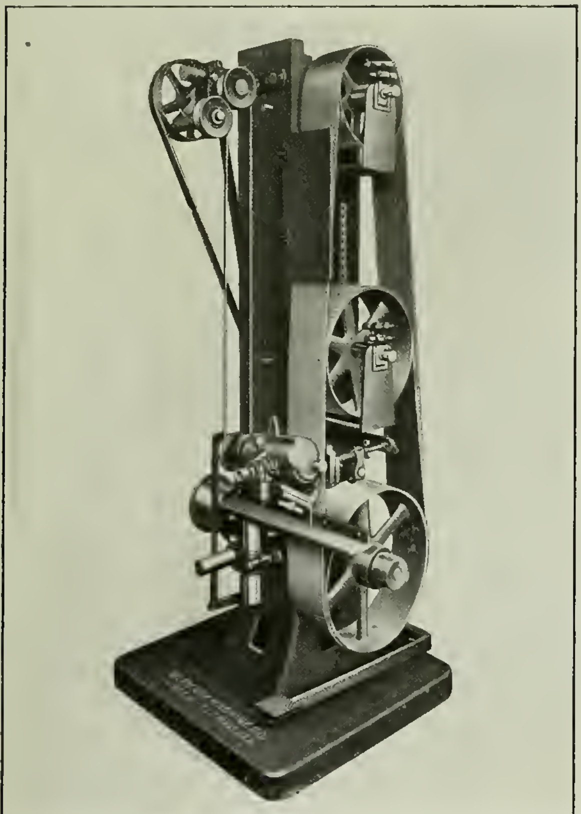
push pin and may be secured or released instantly without using a wrench; all gears are fully guarded. The tailstock has a large spindle with a self-discharging center.

The cross-feed screw on the carriage is supplied with a micrometer collar graduated to read in thousandths of an inch, secured by friction spring and readily set to any position. An adjustable stop for the cross-slide is provided for screw cutting, etc. Feeds may be thrown in or out by turning a hand knob on the apron, which operates a friction clutch. The automatic power cross feed is indispensable for good work; it insures accurate results and smooth surfaces when facing and other similar work. A new safety device is provided in the apron, so that the opposing feeds cannot be engaged at the same time.

The countershaft has two improved clutch pulleys with a large friction surface on the rim of the pulley. Wear on friction parts when the pulley is running idle is eliminated. The net weight of these machines varies from 720 lb. in the 4-ft. model to 985 lb. in the 7-ft. model, complete with countershaft.

AN ADAPTABLE FINISHING AND BUFFING MACHINE

FOR rapidly polishing and finishing round, flat or curved shapes, grinding flue and tube ends, buffing nickel plated parts, such as car fittings and fixtures, the vertical abrasive finishing machine, embodying a patented two-belt system of finishing, with an abrasive cloth belt running at high speed over a heavy corrugated leather cushion belt, is a most important development in the art of abrasive finishing. Without mechanical holding device or power feed attachment, the work is held by hand and produces a finished product of a superior nature, whereas with a mechanical holding device and the power feed attachment, the machine becomes automatic in operation and its production is limited only by the ability of the operator to handle the work, which can be performed by unskilled labor.



Vertical Abrasive Finishing Machine

The Blevney Machine Company, Greenfield, Mass., will exhibit one of its type A-6-14 machines illustrated herewith, as well as one of its type *F* horizontal finishing machines and a type *A* automatic polishing and finishing machine with power feed attachment, at Atlantic City.

The machine has a heavy cast iron column, providing the necessary rigidity for high speed operation. Steel ways are attached to the column, and the sliding frames in which the idler pulleys operate travel on these ways. The cushion belt is run over the main pulley and the idler next above, traveling at a speed of 7,000 ft. per minute. The cloth abrasive finishing belt is placed over the cushion belt but extends to an idler pulley at the top of the machine. The idler pulley frames in both cases are governed by weighted levers having a fulcrum journaled wheel and steel pinion, forming connection with a steel rack attached to the frame. These weighted levers stand in a horizontal position when the machine is in operation and are governed by a spring which holds the pinions in engagement with the rack. By pulling the fulcrum against the action of this spring the pinion becomes disengaged and the lever may be moved to any desired position, the spring restoring the engagement between the pinion and the rack.

The alinement of the two belts may be controlled by means of the handwheels on the idler pulley boxes, these wheels serving to tilt the pulleys so that the position of the belts may be changed as desired.

A suitable holder or stock rest is provided for holding the stock and for the application of fixtures and attachments. A spring platen or pressure bar is applied back of the cushion and finishing belts, the action of which is controlled by a foot treadle; stops are furnished to limit the forward and return movement of the platen. The face of the platen is made to suit the work to be finished. For plain flat work, the platen has a plain face, whereas, for finishing tubes or round pieces, parallel strips are placed at the top and bottom of the platen, causing the belt to curve around the circumference of the stock being finished. Where desired the platen may be made sectional, or special rotating platens may be furnished with yielding centers.

The productive powers of this machine are made possible through the use of the two-belt system. The corrugated leather cushion belt runs at 7,000 ft. per minute; the cloth abrasive finishing belt which runs over it operates at a slightly increased rate of speed, due to the larger driving member, which is increased in size by twice the thickness of the cushion belt. The increase in speed is slightly more than one inch on each revolution of the main pulley. This creeping is neutralized in operation when the pressure is applied behind the belts, with the result that the travel of the abrasive belt is somewhat retarded at the point of work, so that it must curve into the high and low sections. In this manner high points are obtained for cutting and low points for chip recesses. The corrugations in the leather cushion belt assist in providing chip recesses. After the belt has passed the point where the work is held, it, of course, resumes its normal position and this action throws off or expels.

the chips. A joining machine is used in making the abrasive belts endless; the method employed is such that the thickness is practically no greater at the joint than at any other part of the belt. By this process, not only is a strong belt possible, but one which runs smoothly and evenly and does not jump over the work at the point of joint.

Coarse belts after being first used for roughing, are later dressed down for finishing in various stages until they are finally used as greased belts for the finest finishing.

The cloth abrasive belts do away with centrifugal action upon the finishing grains when they are under strain and provide a uniform speed for each cutting grain. It is claimed that there is practically no loss in abrasive material through the use of the cloth finishing belts.

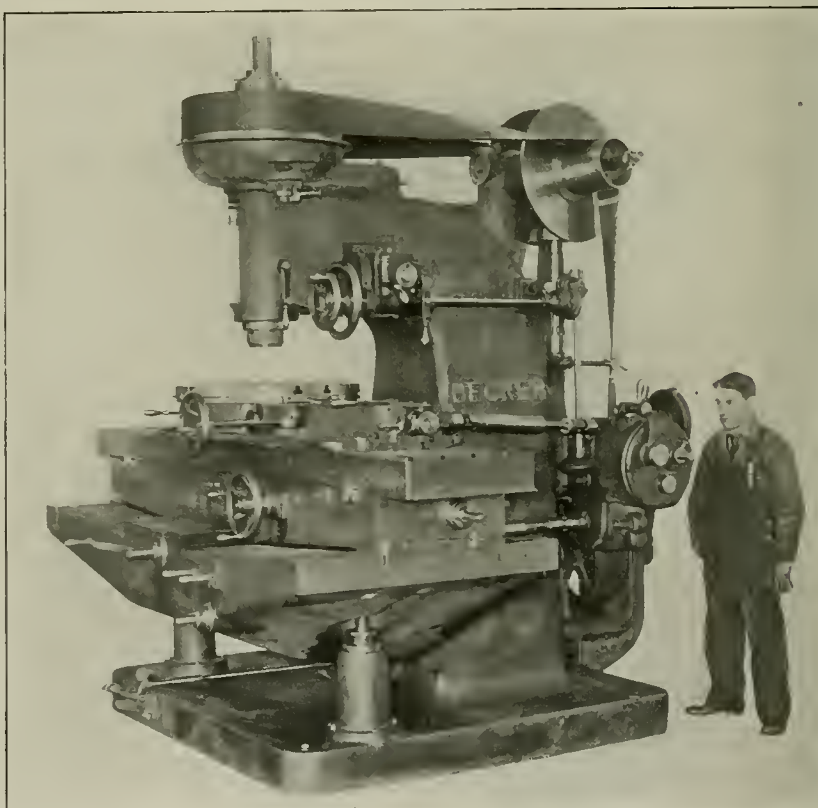
A MONSTER VERTICAL MILLING MACHINE

The model D-1 vertical milling machine, shown in the illustration, is perhaps the largest machine of this type ever built, and was developed primarily by the Becker Milling Machine Company, Hyde Park, Boston, Mass., for die sinking work in connection with the drop forging industry. When equipped with a rotary table, however, it is specially adapted to heavy milling work. The machine weighs approximately 18,000 lb.; the greatest distance between the spindle and the main table is 22 in., and between the spindle and the rotary table 13 in. The greatest distance from the center of the spindle to the frame is 25½ in. Aside from its large size, however, the machine includes several important and interesting features.

It was necessary to make the movable knee (96 in. long) of specially heavy design; it is supported by telescopic screws at each end and on the frame by the Becker patent gib. The screws are accurately co-ordinated so that they work in perfect unison. The knee is elevated and depressed by a single control wheel when operated by hand, but this operation may be performed by power by simply throwing in a clutch. The knee has a vertical feed of 20 in. The saddle, of rigid construction, has three bearing points on the knee. It is of extra length (96 in.) and supports the movable table throughout its entire length.

All of the control levers are centrally located so that the operator can watch the work and control the machine without undue exertion. The table is provided with power rapid traverse in either direction and a fine hand adjustment from the operator's position in front of the knee or at either end of the table. Hand adjustment for the cross and vertical feeds is provided for at the center of the knee. The table has a working surface 20 in. wide and 96 in. long with an over-all working surface 110 in. long. It has a longitudinal feed of 79 in. and a cross feed of 20 in. There are three T-slots ¾ in. wide; also oil grooves on the sides of the table with an oil pan at each end for collecting the lubricant. Micrometer dials are provided on the transverse and longitudinal feeds and the Becker micrometer stop gage in the spindle head provides for operations requiring decimal accuracy.

The spindle is of the Becker-Barrell type construction and is provided in addition to the above-mentioned micrometer stop gage with an adjustable automatic stop, and a fine hand adjustment and quick return mechanism. The spindle has a vertical power feed of 13 in. and is back geared and driven by a 6-in. double belt in order to insure smooth action and the elimination of chatter. It has a main bearing 4 in. in diameter and 9⅞ in. long. The feed per revolution of the spindle with open belt is .003 in. to .09 in., and with back gears .013 in. to .46 in. Three changes of feed are obtainable by means of gearing in the feed box, but a wide range of feeds of any desired amount within the above limits may be obtained by the Becker patent friction feed.



Becker Standard Model D-1 Vertical Milling Machine.

When belt driven the machine is provided with a single pulley drive having a gear box with seven changes of speed, thus giving the spindle 14 speeds, ranging from 45 to 260 r. p. m. with the open belt, to 9 to 51 r. p. m. with the back gears. The machine may, however, be arranged for a 10 h. p., 850 r. p. m. motor, or for a motor having a speed range with a ratio of 4 to 1, in which case the speed box is not necessary.

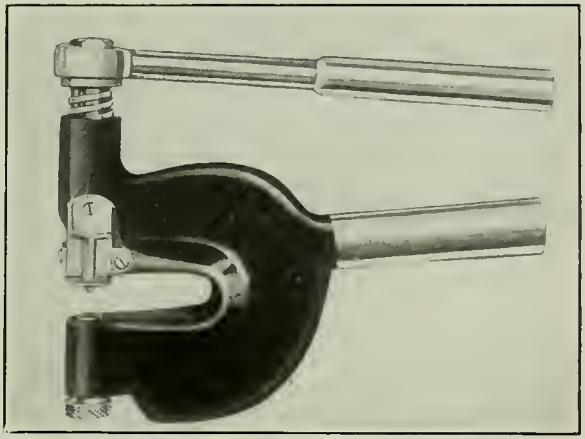
PORTABLE QUICK-ACTING HAND PUNCH

A PORTABLE and compact punch, which at the same time is powerful and quick-acting, has recently been placed on the market by Paul W. Koch & Company, Chicago, and is known as the "Jiffy" punch. It weighs five pounds, is 9½ in. long, will work in a small space, and punches holes up to ¼ in. in metal as heavy as 10 gage. Very little oiling is required and no adjusting.

As may be seen from the illustration, the throat is deep and this, with the one-piece, automatic, disappearing stripper, gives a clear view of the punch and punch mark for the next operation. Several sheets may be punched with one operation.

The crowned punches of the floating type direct the power to the center and will not twist or turn during the operation, thus reducing the possibility of punch breakage. These punches do not leave a burr on the metal.

Several features contribute to the convenience of the operator. Among these is the absence of long, clumsy handles; the operator is brought close to the material and can follow the punch marks quickly and accurately; only a half turn of the lever is required to drive the punch through the metal; the handle is above the center and naturally tends to keep the punch upright.

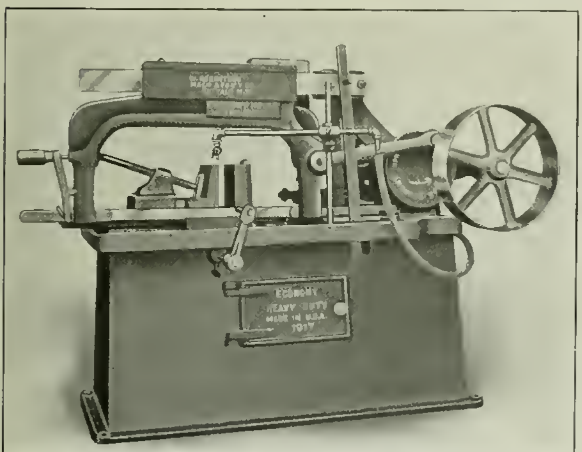


"Jiffy" Portable Speed Punch

The punches and dies may be changed easily. There may be some classes of work with which it is desirable to clamp the punch in a vise; this can readily be done with the Jiffy punch.

A POWER METAL SAW WITH TWO SPEEDS

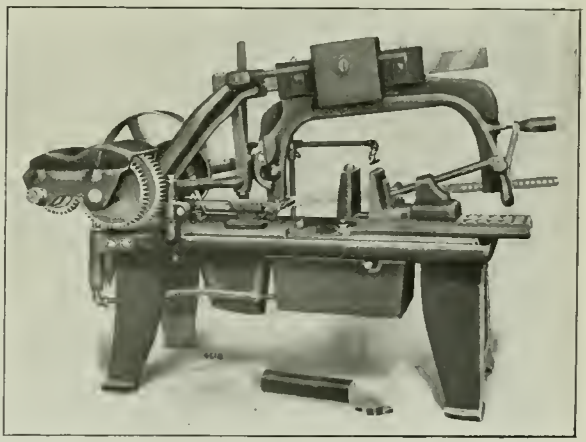
A HIGH speed power metal saw arranged to provide two speeds is being built by the W. Robertson Machine & Foundry Company, Buffalo, N. Y. The latest model, known as Economy No. 40, has a capacity for cutting material up to 8 in. by 8 in. in section. The two speeds make



Front View of Power Saw With Box Base

it possible to use the proper speed for either hard or soft metals. The arrangement for changing speeds is simple. Two pinions—24 and 32 teeth—are mounted on the back or driving shaft; they mesh with gears on the crank shaft having 58 and 50 teeth respectively. There is a hardened steel clutch between the pinions on the back shaft, which can be made to engage with either one of the pinions or take a neutral or central position, leaving the machine idle. The clutch is operated by the knob at the end of the drive shaft. The machine stops automatically when the cut is completed.

These saws are arranged to cut on the draw stroke and lift on the idle or return stroke, thus relieving the teeth of all drag. This is controlled by what is known as an oil lift which consists of a two-cylinder pump submerged in a tank of oil. One piston is connected with the frame which carries the saw and the other with the crank shaft. At the end of the cutting stroke, oil is forced under the piston connected to the frame, lifting it, and at the beginning of the cutting stroke the pressure is released as the piston passes a small port, a 1 in. steel ball acting as a valve; there are no deli-



Rear View of Power Saw Showing Back Gears for Obtaining Two Speeds

cate or complicated parts in this mechanism. It is impossible for the frame to fall and break blades while the work is being adjusted.

The cutting lubricant is supplied from a tank in the base of the machine by means of a plunger pump, the oil draining back into the tank. The vise is quick-acting and swivels to 45 deg. for cutting angles. Saw blades from 12 in. to 17 in. are used, No. 18 gage being recommended. A modification of this design, known as the 40B, is fitted with a box base forming a larger receptacle for the cutting compound. A machine of this latter design weighs 600 lb.

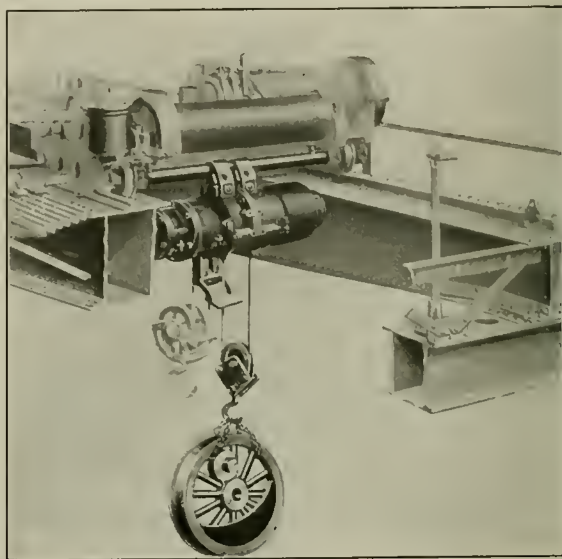
AUXILIARY HOIST FOR TRAVELING CRANES

A SIMPLE and practical auxiliary hoist for attaching to any standard overhead electric traveling crane, has recently been developed by N. B. Payne & Company, 25 Church street, New York.

This hoist can be quickly and easily attached, it does not take up any additional room overhead, does not require an extra trolley, does not shorten the travel of the trolley on the bridge and does not interfere with the accessibility of the main hoist.

The average traveling crane handles a far greater number of light loads than heavy loads. As cranes for lifting heavy loads are slow moving, their use results in a serious loss of time if they handle the light loads. Thus a 20-ton crane with a hoisting speed of 12 ft. per minute will handle a three-ton load at but slightly greater speed, but with the auxiliary hoist a load of three tons may be handled at a speed two to 10 times higher than the speed of the main crane.

This auxiliary also effects an important power saving. Very often the hook and block of the main crane together weigh more than the load handled, and as the auxiliary hook and block are much lighter it is evident that the power saving is appreciable. The labor saving with the auxiliary hoist is another item worthy of consideration, especially when a gang of men must wait to have a small piece slowly moved by a large crane.



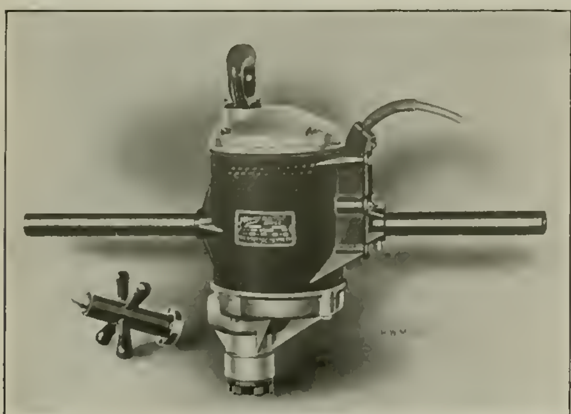
Application of Auxiliary Hoist to Traveling Crane

By the application of this auxiliary attachment any standard single hoist electric traveling crane may be equipped with two lines for drop bucket service. The control may be arranged from cage, floor or pulpit to suit the crane to which it is applied.

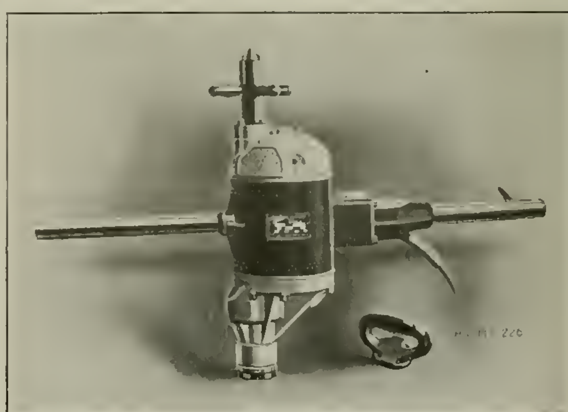
Usually standard auxiliary hoists of from one to five tons capacity, suitable for the type of crane, electrical equipment and type of control, are supplied by the makers to meet ordinary requirements, but larger special sizes are furnished when specified.

ELECTRICAL DRILLING AND REAMING MACHINES

PART of a new line of heavy duty electrical drilling and reaming machines has been completed by the Hisey-Wolf Machine Company, Cincinnati, Ohio. Typical examples of this line are shown in the illustrations. In order to secure the necessary capacity and yet keep the weight within reasonable limits, it has been necessary to use the very best materials and go to the greatest refinements in design. The motor is, of course, the critical part of the machine and special attention has been given to forced ventilation in order to keep the temperature as low as possible; this is accomplished by means of a fan attached to the armature shaft. The machines may be provided with either direct current or

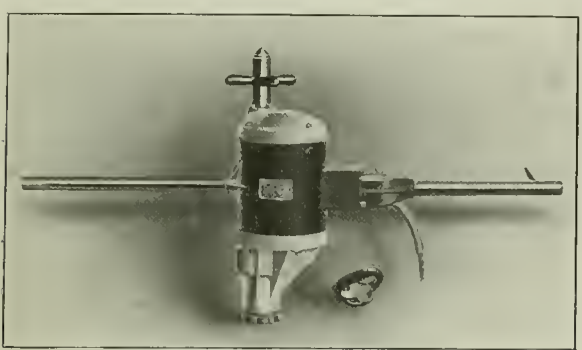


¾-Inch and 1-Inch Electric Drill



1¼-Inch Machine With No. 3 Morse Taper Socket

alternating current motors. The larger sizes are equipped with automatic switches, the instantaneous and positive ac-
contacts.
tion of which practically eliminates arcing and fusing of
The main spindle bearing is made of bronze and is large enough to withstand the effect of the irregular drilling pres-



1¾-Inch Machine With No. 4 Morse Taper Socket

sures. Ball bearings are used wherever applicable; all the bearings are completely enclosed and wherever necessary felt protector washers are supplied. The bearings, gears and other moving parts in the gear end of the motor are supplied with a lubricant from the gear transmission case. The ball bearing on the commutator end is packed with grease.

The side handle, opposite the switch handle, is removable in order to adapt the machines for close corner drilling. In some cases, it is necessary to have perfectly balanced machines, and two sizes of heavy duty drills have been designed with a center spindle drive, the drill spindle being in line with the center of the main body. One of these sizes has a capacity for drilling ¾ in. or reaming 9/16 in. holes in metal, or drilling 1½ in. in wood; the other size has a capacity for drilling 1 in. or reaming 11/16 in. in metal or drilling 2 in. in wood.

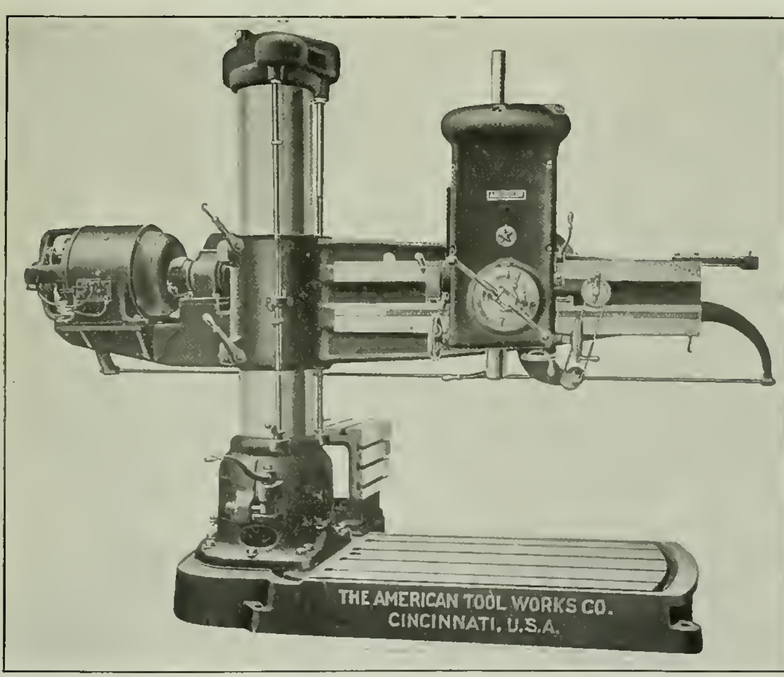
Certain of the machines are designed for two speeds, the change in speed being made by a gear shifting device operated by a thumb nut on the outside of the gear end cap. This insures positive engagement of the gears but speeds may be changed while the machine is in operation.

These drilling machines are not regularly furnished with a breast plate because there is seldom need for this attachment on the larger portable machines; it may, however, be furnished, if desired. The electrical connections are made by means of spring contacts wherever practicable. Provision is also made for renewing the attaching cable without disturbing other parts of the machine.

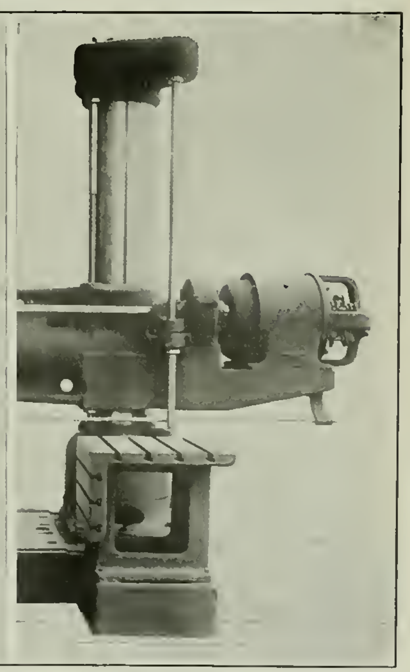
The heavy duty alternating current machines are now available for drilling metal in the following capacities: ¾ in., 1 in., 1¼ in. and 1¾ in. The direct current machines are made for drilling 1¼ in. in metal or 3 in. in wood. Other sizes up to a capacity for drilling 2 in. in metal are expected to be ready shortly.

SIMPLIFIED MOTOR DRIVE FOR RADIAL DRILL

The problem of applying power for driving radial drills has always been a difficult one and it was not simplified by the introduction of the individual motor for driving machine tools. Many of the earlier applications, for instance, required two motors—one for driving the machine, and the other for elevating and lowering the arm. Improvements in the motor drive have, however, been made steadily in recent years and a radical change has now been brought about by the American Tool Works Company, Cincinnati, Ohio, in the application of what it designates as a "Simplified



Simplified Motor Drive for 6-Ft. Triple Purpose Radial Drill



Rear View of Motor and Column

motor drive" to its "triple purpose" radial drills. As shown in the illustrations, the motor is mounted on the arm in such a way as to partially balance the weight of the working portion of the arm and the head; incidentally, this relieves the cramping tendency on the column sleeve, facilitating the swinging of the arm.

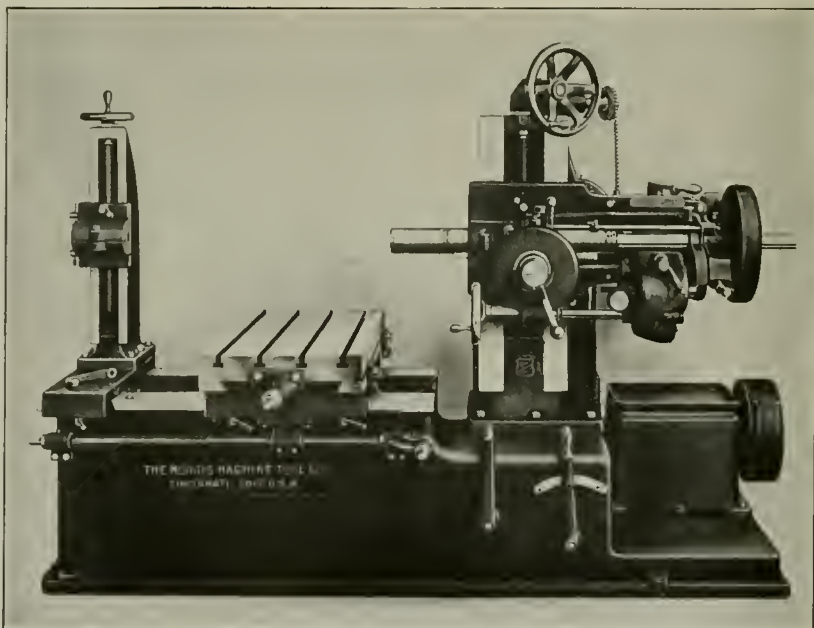
The principal advantages of the new application, however, are in the elimination of a number of bevel gears, spur gears and long shafts which are required when the motor is mounted at the base of the machine. It is estimated that 50 per cent of the gear friction in the drive is thus eliminated and that there is a corresponding decrease in the bearing friction. As a result the cost of maintenance should be very considerably reduced, as well as the amount of power required to operate the machine. Taking the motor off of the floor, away from the dust and dirt, is another desirable feature, not alone from the reduction in wear and tear on the motor, but also from the fact that the space formerly occupied by the motor can be utilized for working purposes. The problem of oiling the machine is simplified because of the smaller number of bearings. The control for the electrical equipment is mounted on the head of the drill making it possible for the operator to start and stop the motor at will and vary the spindle speeds without changing from his working position.

Four mechanical speed changes to the spindle are provided in the head but this is not sufficient where it is desired to handle a variety of work and it is, therefore, necessary to provide a variable speed motor. This limits the application to places where it is possible to secure direct current for the drive. A semi-enclosed 3 to 1, approximately 400 to 1200 r. p. m., direct current motor and a drum type, non-reversing, variable speed controller, of the smallest frame obtainable, are recommended by the makers of the machine. The 6-ft. "triple purpose" radial drill which is shown in the illustration was described in the *Railway Mechanical Engineer* of May, 1917, page 271.

HORIZONTAL BORING AND DRILLING MACHINE

A HORIZONTAL boring and drilling machine, adapted for drilling, boring, facing and tapping has recently been developed by the Morris Machine Tool Company, Cincinnati, Ohio. It is simple in construction and so arranged that all of the control levers are within each reach of the operator. The head, of heavy construction, is counterbalanced and slides on wide ways fitted with taper gibs which are adjustable for wear. The head may be raised and lowered by means of the hand wheel at the top of the column. A steel scale is set in the column and is graduated in sixteenths of an inch; this, in connection with the micrometer collar on the elevating screw, enables readings to be made in thousandths of an inch for the full travel of the head.

The spindle is 1-15/16 in. in diameter at the smallest section with a diameter at the nose of 3-11/32 in. It has a traverse of 17¼ in. The maximum distance between the spindle and the table is 20 in. and between the spindle and the outer support 48 in. The thrust of the spindle is taken by ball bearings. The spindle sleeve is graduated and is provided with a direct reading depth gage. The gears which drive the spindle are helical, the angle of the teeth being just great enough to have more than one tooth in mesh and at the same time avoid end thrust. This insures uniform power at the cutting point of the tool and eliminates any chatter. The feed box is mounted on the head, the feed gears being fully enclosed and running in heavy oil. Six feeds, ranging from .006 in. to .03 in., are available and are marked on a dial in thousandths of an inch advance per revolution of the spindle. The feed may be automatically tripped at any depth within the traverse of the spindle.


Morris Horizontal Boring and Drilling Machine

As may be seen, the speed box is mounted on the end of the bed. It is fully enclosed and the gears run in a light grease. The two vertical levers at the front of the bed directly below the column control the six speeds provided by the speed box. The left-hand lever controls the double friction clutch on the pulley shaft and the right-hand lever three sliding gears. There are 18 spindle speeds in all.

The back gears are made of 3½ per cent nickel steel, are fully enclosed and are mounted on the back of the head. The bearings throughout are of bronze arranged with oil chambers, the oil being drawn into the bearings by felt wipers.

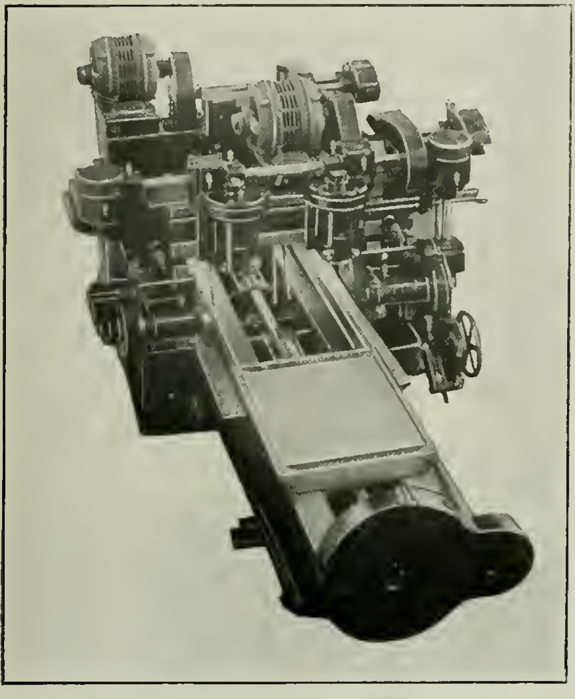
The table has a surface of 20 in. by 36 in., a longitudinal movement of 31 in. and a cross movement of 28¾ in. The top of the table is 31 in. above the floor. The bed is a one-piece box section heavily ribbed; the column is also of box section with as large an area as possible where it rests on the bed.

The machine may be arranged for either a 3 to 1 variable speed motor, connected to the lower shaft by a single pair of gears, or for a 5 h. p., 1200 r.p.m. constant speed motor.

HEAVY HORIZONTAL CONTINUOUS MILLING MACHINE

THE elimination of all possible lost motion and unproductive time in operation is the keynote in the design of the horizontal multiple unit milling machine shown in the illustrations which records a notable advance in the development of this type of machine tool.

Each pair of uprights with its bank of spindles constitutes one milling unit; as many spindles may be mounted on a unit as is considered necessary, and as many units may be attached to the bed as are required to do the work, although two, as shown in the illustrations, are usually considered sufficient. The feed driving mechanism is carried on one unit only.



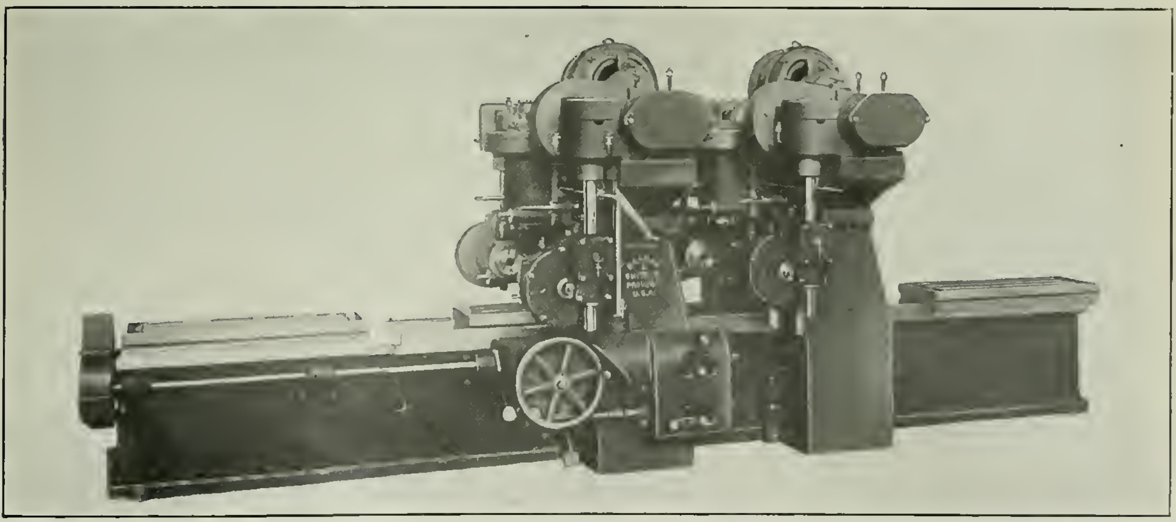
Looking Down Upon Continuous Milling Machine

Removable tables, carrying the work, feed continuously along the bed, taking a fast motion when the cutters are idle and a slow motion when the cutters are working. After passing all of the cutters, the tables are lifted from the bed and the finished work removed. Another table with the work already attached, is placed on the front end of the machine and the process is repeated; as many tables are furnished as are necessary to maintain continuous milling. Such machines will handle on one trip of each table, any milling required on two sides and the top of any piece within its capacity, and by loading the tables to capacity, a large amount of work may be handled in a comparatively short time. The machine once started need not be stopped until it is desired to change the cutters or to accommodate new work.

The bed ways on which the tables travel are flat, with slight tapers on the inside edges to accommodate corresponding tapers on the bottoms of the tables. These center the tables without wedging them and allow them to be put on and taken off rapidly. The tables hold themselves in position by gravity while traveling, except while passing by the cutters, where they pass under gibs, fastened to the bed, which hold them against all vertical movement while the cuts are being taken. A feature of the table design is the narrow guide which is tapered; this makes for the maintenance of a greater degree of accuracy through a longer period than the common wide guide; there is a taper gib to take up the wear.

A feed shaft, which runs the entire length of the bed and is driven from the front end, carries a series of worms which engage in a rack on the bottoms of the tables and are spaced at such intervals that the traveling tables are picked up by one worm before they have completely left the other. The spacing of the worms makes it impossible to set a table in the wrong position on the bed, so that no matter where it is set, it will pick up and travel instantly. The tables have feed in one direction and fast motion controlled by hand in both forward and reverse.

There are four changes of feed through the gearing, providing a variation of from approximately 3 in. to 8 in. a minute, with a fast motion of about 12 ft. a minute when the cutters are idle. Two changes of feed are possible through



Continuous Milling Machine

change gears at the end of the gear box and two more are possible through a feed gear shifting lever. The feed and fast motion are controlled by one lever which makes it impossible to throw in both at the same time. The object of the feed gear shifting lever is to slow down the feed as occasion may require. The feed mechanism is driven by means of a vertical shaft connected through bevel and reducing gears to the main drive shaft.

Each unit is motor driven. The motor and driving mechanism are carried on the crossrail, and the drive shaft is geared direct to the motor which, through reducing gears, drives the vertical and horizontal spindles. Through change gears which are easily accessible the spindles can be given various speeds.

The heads are of rigid construction, cast in one piece, and are adjustable along the ways by means of hand operated screws; the wear may be taken up by taper gibs. When a cutter is located the head is clamped firmly in position.

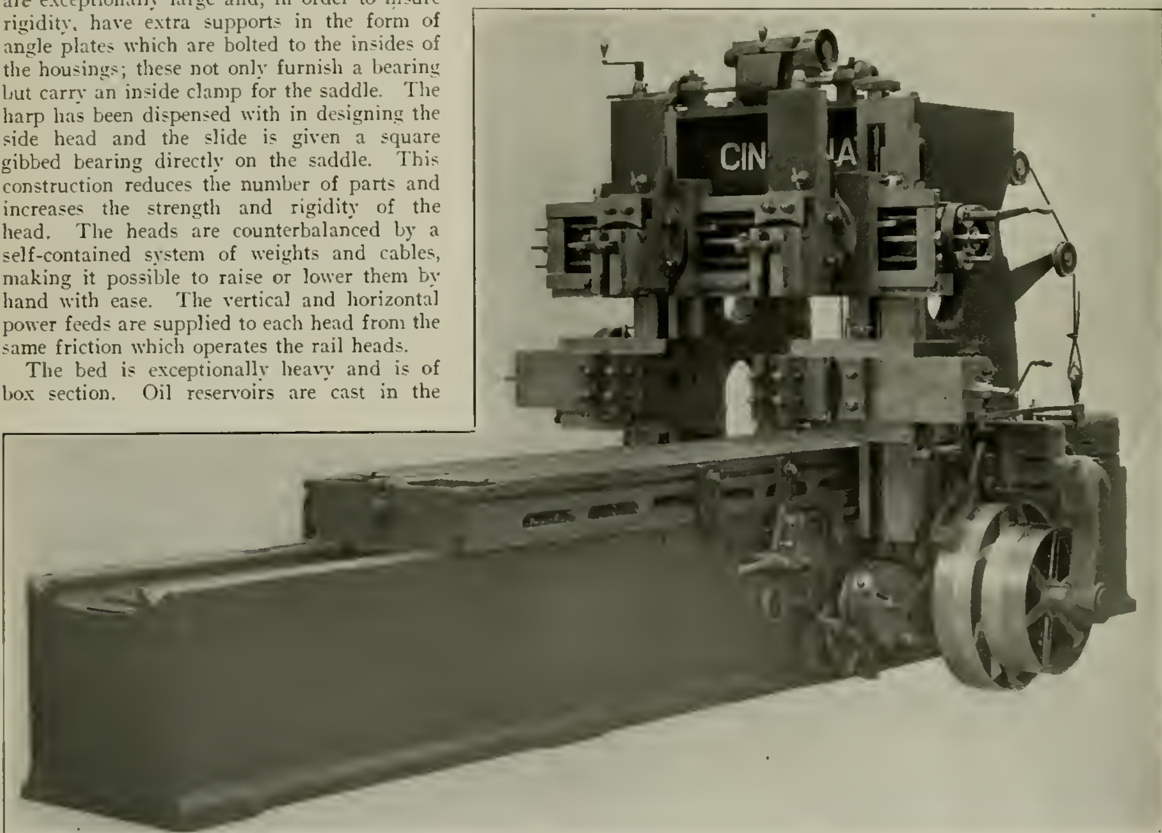
Spindles are furnished in three standard sizes, the largest diameter in the front bearings being $3\frac{5}{8}$ in., $4\frac{5}{8}$ in. and $5\frac{5}{8}$ in. All sizes may be incorporated on one machine and in heads located as the occasion requires; they are furnished with adjustment in and out of the heads, by pinion and rack. The pinion is held in the head and the rack is on the spindle quill. The quill is held in its final position by being clamped and the machine is controlled at the unit which carries the feed gears. One of the illustrations gives an idea of the relative proportions and arrangements of the machine from the starting end and shows a work table in position for feeding toward the first unit.

These continuous milling machines are manufactured by the Beaman & Smith Company of Providence, R. I.

EXTRA HEAVY DUTY OR SPECIAL FORGE PLANER

What is known as a 30-in. Cincinnati special forge planer has recently been built by the Cincinnati Planer Company, Cincinnati, Ohio, for extra heavy work. Special attention was given to the design of the side heads; some idea of the substantial construction of these heads may be obtained from the photograph. The saddles are exceptionally large and, in order to insure rigidity, have extra supports in the form of angle plates which are bolted to the insides of the housings; these not only furnish a bearing but carry an inside clamp for the saddle. The harp has been dispensed with in designing the side head and the slide is given a square gibbed bearing directly on the saddle. This construction reduces the number of parts and increases the strength and rigidity of the head. The heads are counterbalanced by a self-contained system of weights and cables, making it possible to raise or lower them by hand with ease. The vertical and horizontal power feeds are supplied to each head from the same friction which operates the rail heads.

The bed is exceptionally heavy and is of box section. Oil reservoirs are cast in the girths at each end in order to catch all of the used oil and hold it until it may be drawn off through the plug in the end of the bed. The improved box type table is specially heavy and of unusual depth. The bottom side is entirely closed; chips cannot, therefore, drop through the table but are collected on the inside and may be removed through the cored holds at the sides. Heavy ribs at short intervals tie the top and bottom of the table securely together, thus preventing any possibility of springing either when clamping the work on the table or while the table is at the limit of its travel. The table is also gibbed to the bed to prevent any tendency to raise as the tools enter a heavy cut.



Thirty-Inch Cincinnati Special Forge Planer

The housings are of box type and in addition to being keyed are securely bolted and pinned to the bed. They are tied together at the top by a heavy arch, thus insuring rigidity when the rail is in its highest position. As may be seen, the rail is quite deep and has an extra deep box brace on the back to provide additional stiffness. The two heads are right and left hand and can therefore be run very close together. The slides are of extra length and have a full bearing on the harp at all times. The heads are equipped throughout with taper gibs to compensate for wear. It has also been necessary to provide special tool blocks of heavy design which are so arranged that the tool will be held in a perpendicular position.

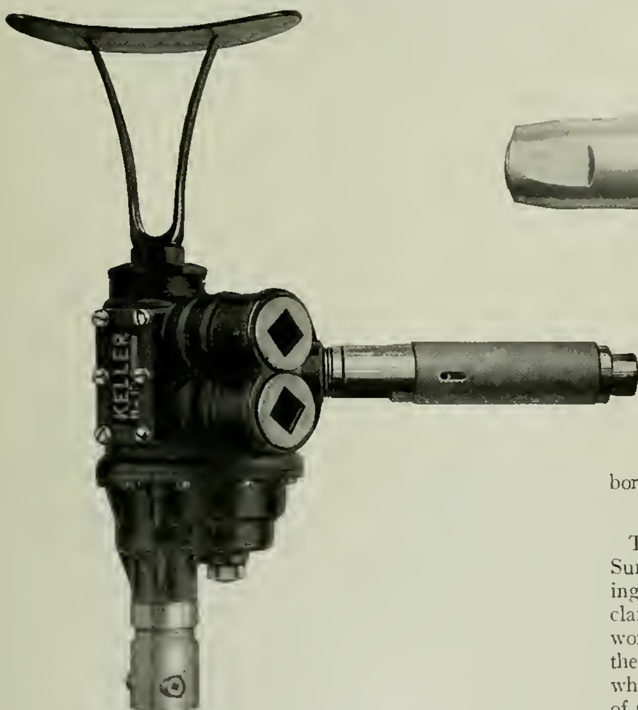
The side heads may be run down completely out of the way of the rail heads. The planer is arranged for a motor drive from the top of the housings but it can be modified to suit any other type of drive. Steel gearing and racks are used throughout. The driving gears are of chrome nickel steel; all high speed bearings are of bronze.

VALVELESS AIR DRILL AND NEW CHIPPING HAMMER

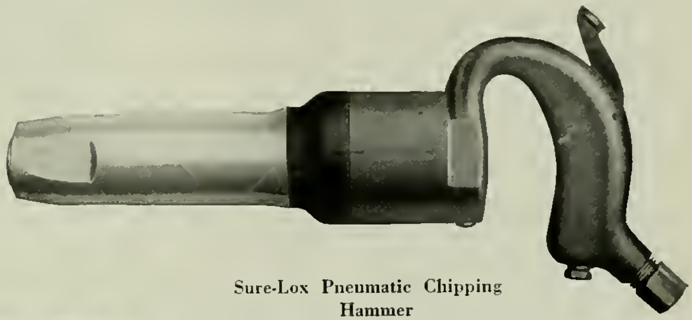
PROBABLY no tools used in a railroad repair shop require more ingenuity in design and more accuracy in workmanship than do the air operated drills and hammers. Two new tools have recently been placed on the market by the Keller Pneumatic Tool Company, Grand Haven, Mich., which possess novel features. The one containing the most radical improvements is a valveless drill.

Valveless Air Drill

Because of the elimination of the delicate valve mechanism it has been possible to make an air drill which is exceptionally light and compact. It is claimed that it will stand up under the most severe service and that it is exceptionally economical in air consumption. These features should, of course, be reflected in the cost of maintenance and the amount of time that the drills will be out of service for repairs.



Keller Master Valveless Air Drill



Sure-Lox Pneumatic Chipping Hammer

Four single-acting pistons are arranged in pairs at right angles, each pair connected to opposite wrists of the crank shaft. This is said to insure smooth running and freedom from vibration. The one-piece cylinder body is provided with handhole openings which are covered with removable plates, affording ready access to the crank connections. The connecting rods and pistons are made of vanadium steel; the rods are fastened to the pistons by ball and socket joints secured by ingenious locking devices which permit replacement of either the connecting rod or the piston. The crank shaft is a drop forging, hardened and micro-ground, and is amply large to prevent springing. It is mounted on liberal size annular ball bearings, thus insuring a minimum amount of friction and wear. The connecting rods are attached to the cranks by means of toggle joints secured with lock nuts; these also serve to stiffen the rods.

The main gear is cut from a solid blank of high-grade steel and is enclosed in a separate case which is filled with grease, thus insuring independent and continual lubrication. The spindle bearing is extra long with an additional bearing where it joins the crank shaft, thus protecting the spindle and the casing from heavy stresses when used on severe work or when the drill is used in a horizontal position. These drills are built in non-reversible or reversible types, including a reversible wood boring machine and a reversible grinder.

Sure-Lox Pneumatic Chipping Hammer

The new type of pneumatic chipping hammer, known as the Sure-Lox, is so named because of the peculiar manner of locking the handle to the cylinder. This eliminates the old-style clamp-bolt which was often objectionable, particularly for work in close quarters. The new handle is locked directly to the cylinder in a positive and rigid manner by means of a key which is inserted in the cylinder and engages one of a series of slots in the handle. The key is securely held in place and the entire lock arrangement is covered by a neat spring clip. All projections or obstructions which might interfere with the convenient handling of the tool are eliminated.

Another novel feature of this hammer is the extra long striking end on the piston. This is 5/8 in. instead of 3/16 in. as commonly used. The retaining wall in the cylinder is also correspondingly strengthened, adding to the durability and adaptability of the hammer. The moving parts are all hardened, ground and lapped to size. The parts are absolutely interchangeable. The hammers may be furnished with either open or closed handles in 10 sizes, ranging from 1 1/4-in. to a 4-in. stroke.

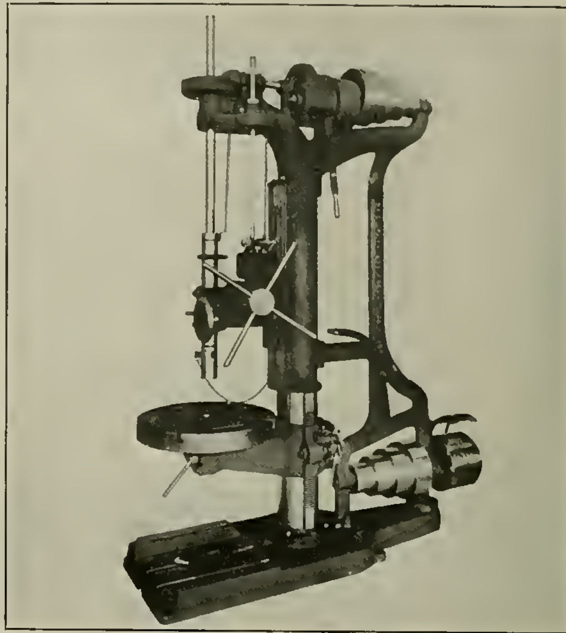
UPRIGHT DRILLS COMPLY WITH STATE LAWS

The Aurora Tool Works, Aurora, Ind., has recently improved its 28-in., 32-in. and 36-in. sliding head drills by the doing away with the so-called gear covers and thoroughly enclosing the gears to have them comply with the various state laws. Incidentally this has added greatly to the appearance of the machines, as is indicated by the illustration.

These drills are designed for heavy duty. The column, spindle, sleeve and all shafts are ground. The spindle is provided with a ball thrust bearing and is driven by bevel gears having a ratio of 3 to 1. The maximum distance from the spindle to the base on the 28 in. machine is 50 in., while the maximum distance from the spindle to the table is 36 in.; the machine will drill to the center of 28½ in.

The spindle has a diameter of 1-11/16 in. above the sleeve, and has a traverse of 12 in. The feeds are positive and easily controlled by the operator; they are .007, .012, .016, .021, .033, and .046 in. per revolution of the spindle. An automatic stop is provided so that the feed may be disengaged at any predetermined depth; the sleeve is graduated. The table on the 28 in. machine is 24½ in. in diameter and has a traverse of 15½ in. The table arm has a large flat bearing on which the table rests; the arm is bored and faced in place, thus giving each drill a thorough test before leaving the shop. The head has a traverse of 23½ in. It has a long bearing on the column and slides on wide ways, being controlled by means of a rack and pinion.

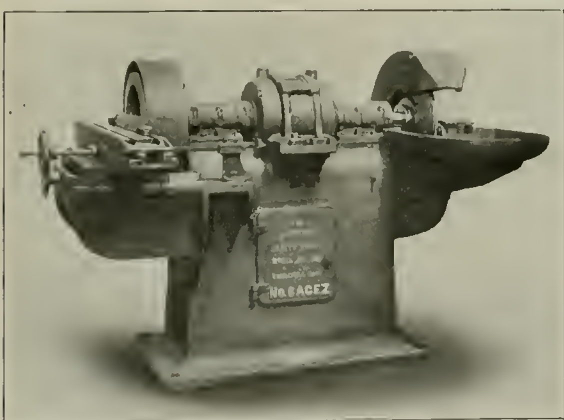
The machine shown in the illustration is arranged for a belt drive, hut a 3 hp., 1,400 r.p.m. motor may be applied.



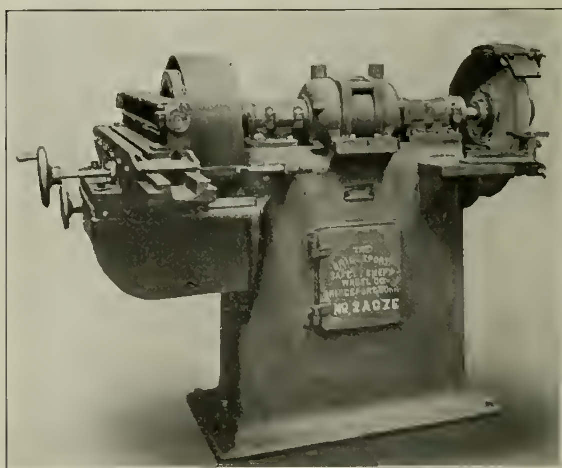
Aurora 28-Inch Upright Drill

COMBINATION MOTOR DRIVEN GRINDERS

The combination grinders shown in the illustrations are specially valuable where there is only a limited amount of work of any one kind and where floor space is limited. The combination practically furnishes two machines to occupy the space of one. These machines, which have been developed by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn., may be made in a number of different combinations, but in each instance the heavy bracket is cast at the left-hand end of the cabinet. The top of this bracket is finished to receive a dove-tailed table which is gibbed to the bracket and is fed back and forth on the base by means of the hand wheel and screw. On the top of this table and pivoted at the center is a bed which may be tilted in such a way as to grind slightly concave or it may be set square to grind perfectly flat. Clamping screws at each corner will hold it securely in any desired position. On top of this bed and dove-tailed to it is a carriage (34 in. long and 6 in. wide) with two T-slots. This is gibbed to provide for wear and is operated back and forth in front of the grinding wheel by means of a rack and pinion which is controlled by a hand wheel. The work may be clamped to the carriage, or if desired a magnetic chuck may be provided.



Combination Grinder with Wet Grinding Attachment at the Right



Combination Grinder with Knife Bar at Left

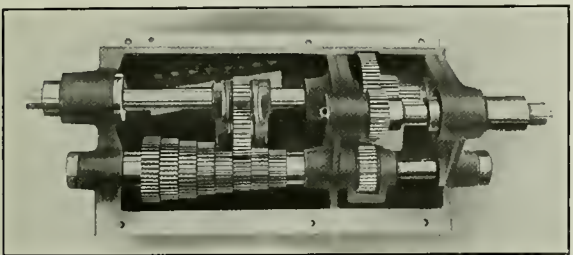
One of the illustrations shows a knife bar on this carriage for grinding machine knives; by means of this arrangement, the knives may be set to grind at any angle or square across. The photographs show two different arrangements of grinding wheels at the right-hand side of the machine. In one instance, a wet tool grinder is furnished, while in the other an ordinary type of floor grinder is used. If desired a twist drill attachment may be furnished.

The motor is equipped with a special frame, so that it fits well down into the base of the machine; it has a large spindle, the diameter in the bearings being 1¾ in. The distance between wheels is 35 in., and the length of the shaft over-all 50 in. The height from the floor to the center of the spindle is 40 in. There are two sets of balls in each of the ball bearings, these bearings being 10½ in. in length.

The machine covers a floor space, not including the overhang, of 45 in. x 23½ in., and weighs 1,800 lb., when crated for domestic shipment.

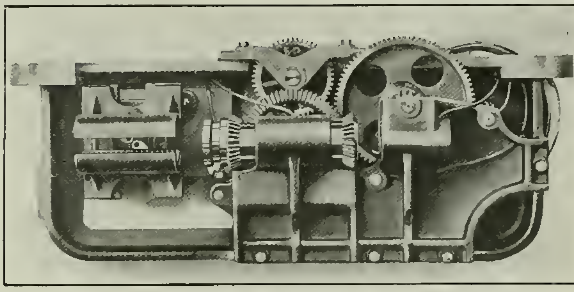
THIRTY-SIX INCH MOTOR DRIVEN GEARED HEAD LATHE

The Pittsburgh Machine Tool Company, Braddock, Pa., has recently redesigned its line of heavy lathes. In general, the 36 in. x 12 ft. lathe, which is described herewith, is typical of the other sizes. This particular lathe has a swing over the ways of 36¾ in., a swing over the carriage of 25½ in. and a distance between centers of 5 ft. The headstock is of the enclosed type and so constructed that it can be easily dismantled. Twelve changes of speed are provided through the head and are controlled by two clutches and three gear shifts; the ratio of the gearing in the head is 63.5 to 1.

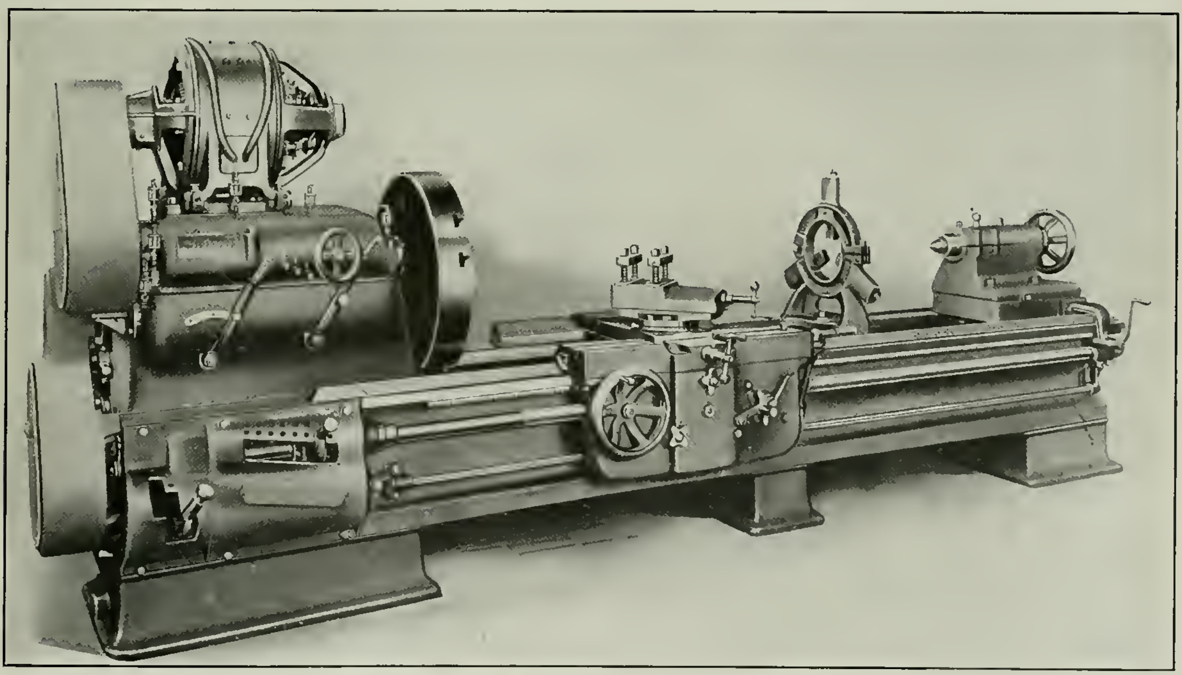


Interior of Feed Box

A motor drive may be supplied as shown in the illustration. With a direct current motor any reasonable number of spindle speeds may be obtained by the use of a variable speed controller which is operated from a handle at the right hand end of the carriage. If an alternating current motor is used, it is controlled by a Cutler-Hammer rotary switch and automatic starter. If a belt drive is desired, a 6 in. belt is used and 24 spindle speeds may be obtained with a two-speed countershaft. The main spindle is of hammered steel and hollow. The front spindle bearing is 6 in. in diameter and



Interior of Apron



Pittsburgh 36-Inch Geared Head Lathe With Motor Drive

8 in. long, while the rear spindle bearing is 4 in. in diameter and 6 in. long.

The feedbox furnishes 41 different lateral feeds; power cross feed is also supplied. The tailstock is of heavy design and is arranged with a pawl which engages with a rack cast in the center of the bed. The tailstock is moved by power through gearing. The tail spindle is 4½ in. in diameter. The apron is of double bearing construction; its arrangement is clearly shown in the photographs. A locking device prevents the throwing in of two feeds at the same time. The carriage is fitted with wipers which ride on the vees, keeping them clean and well oiled. The bridge is 12 in. wide and the carriage has a bearing on the ways of 44 in.

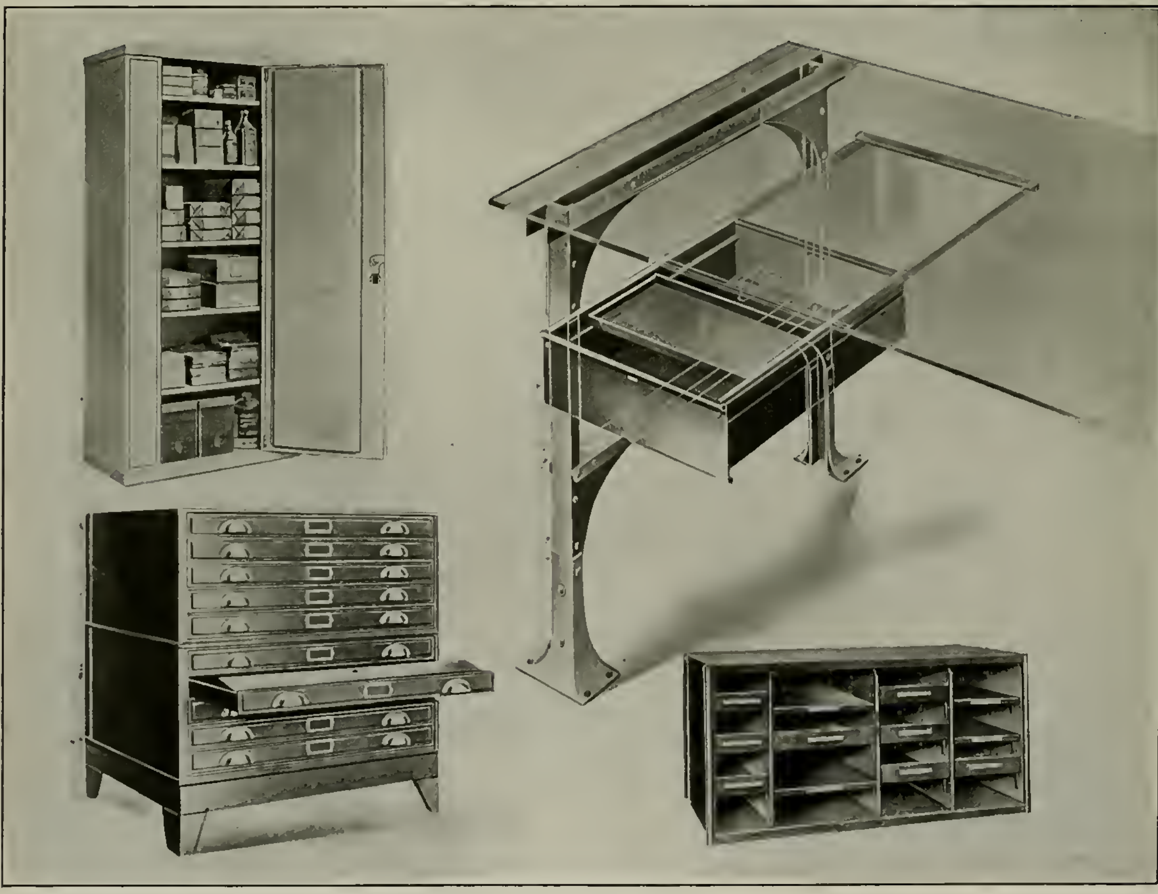
The bed is 29 in. wide and 20 in. deep. The front vee is exceptionally large to provide ample front bearing for the carriage. The taper attachment is of strong and rigid construction. The net weight of this machine with a 12 ft. bed is 16,000 lb.

PRESSED STEEL EQUIPMENT FOR SHOPS AND OFFICES

The many small cabinets, bins, drawers and boxes used around shops and roundhouses are as a rule made in the car shop. The cost of manufacturing them is necessarily high but there has been no alternative in the past as suitable equipment could not be secured otherwise. To meet the demand for such articles the Lyon Metallic Manufacturing Company, Aurora, Ill., is now producing a number of the types most commonly used in a variety of sizes suitable for railroad use. Being made of steel they are light and strong and more durable than similar equipment constructed of wood.

For tool rooms and store rooms a subshelf has been developed which simplifies making small compartments. The unit is collapsible and adjustable and fits into the standard Lyon shelving, which consists of a number of uprights into which clips can be set to hold the shelves. By reversing the shelf the compartment may be made into a bin. The shelves can be adjusted on 1½-in. centers without the use of tools and when not in use can be knocked down so that they consume practically no space.

Another useful adjunct for shops and roundhouses is a blueprint cabinet so arranged as to permit the storing of many sizes of drawings in a single size of cabinet. One of the principal advantages of these cabinets lies in the fact that they are fireproof. The cabinets are finished in baked enamel and can be furnished in five drawer sections ranging in size from 24 in. by 24 in. to 48 in. by 36 in. This device is shown in the illustration as well as a different type designed for the storage of a workng supply of stationery and printed forms. The size of this cabinet as regularly made is 36 in.



Shelving, Cabinets and Drawers Designed Specially for Shop Use by 18 in. by 75 in. It has movable shelves and can be securely locked.

Shop men who have been troubled with the loss of valuable tools will be interested in a thief-proof, steel bench drawer. It is equipped with a one-piece steel top which is also used to form the slide. Although the drawer may be torn from the bench and be entirely separated from it, the contents will still be secure.

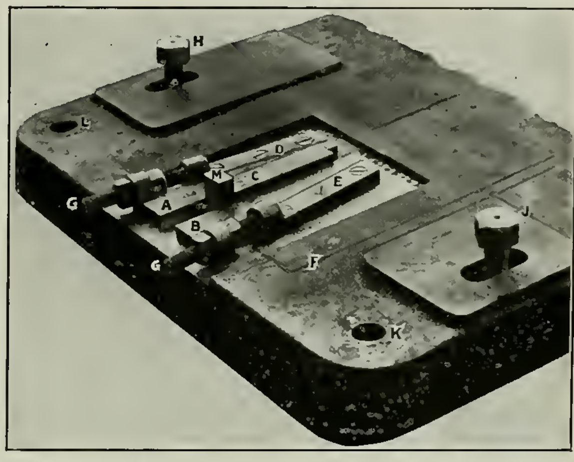
ADJUSTABLE ANCHORAGE FOR MOTORS

A DEVICE designed to insure accurate alinement and permanent anchorage for electric motors is being marketed by the Adjustable Anchorage Company, 1502 Ford building, Detroit, Mich. This anchorage permits a limited adjustment of the motor in all directions and may be used on either direct connected or belt-driven motors.

A half-view of a bed plate with the anchorage applied is shown in the illustration. The motor is set on the bed plate with keys *C* set tightly in slots in the bottom of the motor at both ends, the lugs *M* pressing against the motor base. To rotate or move the motor to either side, the bed plate bolts *H* and *J* are loosened and the wedges *A* and *B* moved alternately in or out by means of the screws *G*. The wedges bear on the surface of the guides *D* and *E*, the taper of the wedges thus moving the keys laterally, which in turn move the motor with them.

This anchorage, by providing universal adjustment of the motor in a horizontal plane, makes possible an accurate alinement, which once obtained is permanently held by the key *C*. This is of particular value in the adjustment of magnetic clutches and in the perfect alinement of the shaft, which eliminates eccentric movement and thus prolongs the life of the journal bearings.

To tighten or loosen a chain or belt the key *C* is loosened by drawing out the wedges slightly and moving the motor by means of a screw set in a lug cast on or a stud tapped in the bed plate at *F*. This device may be installed on old motors or on new work at a comparatively small cost.



Arrangement of Adjustable Anchorage for Motors

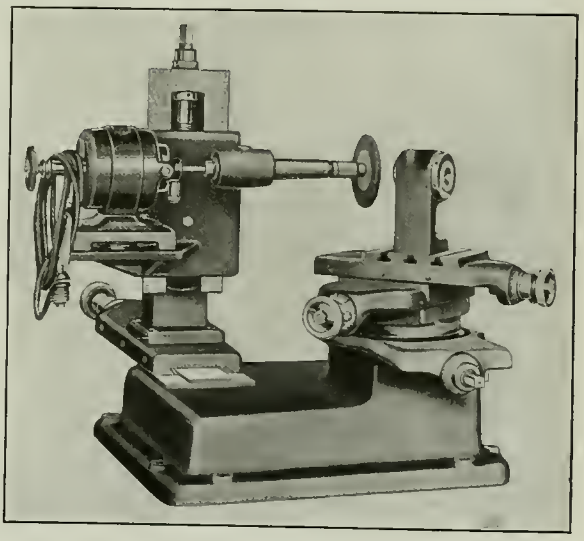
SOLVING THE CUTTER GRINDING PROBLEM

THE truth of the old adage that "Necessity is the mother of invention" is brought out in the production of a new profile grinder, which was originally designed and constructed exclusively for the requirements of a large milling cutter establishment. The performance of this machine, which is shown in the photograph, in its grinding of concave and convex cutters, cutters for fluting drills, rounding corners on side and face mills, and other special grinding jobs, has been considered of sufficient value to cause its originators and manufacturers, the Cleveland Milling Machine Company, Cleveland, Ohio, to place it at the disposal of manufactories and repair shops for installation in their tool rooms.

The wheel carrying spindle is direct connected to the shaft of the type *D* Dumore universal 110-volt motor which is furnished with the machine. The spindle has adjustable bronze bearings and carries a wheel 4 in. in diameter, ¼-in., face with a ⅜-in. hole. The bracket carrying the motor and wheel spindle is mounted on a vertical housing and is adjusted by a screw provided with a micrometer dial.

Arbors for holding the work are held in a sleeve which revolves freely in the work holding posts. Four posts are furnished with No. 9 and No. 7 Brown & Sharpe tapers, one with a ½-in. straight hole and one flat block for holding flat tools, in order to cover all classes of work capable of being done on the machine. The posts fit into three T-slots in the upper compound slide, thus providing for a wide range of work. The two upper slides are used to bring the work in the proper sweep across the face of the wheel, and are in turn mounted on a swivel block, which is pivoted to the bottom slide.

The maximum radius that can be ground is 3 in. on either concave or convex cutters up to 12 in. in diameter. A gage is furnished to set the work in the proper relation to the wheel and when the slide is set for any given radius the machine will always grind that radius regardless of the continued adjustment of the two upper slides. A simple and



Motor Driven Profile Grinder

convenient tooth rest is furnished with range enough to cover all work within the capacity of the machine. All screws are provided with readable micrometer dials and the slides are accurately scraped and provided with gibs for taking up the wear. The machine occupies a bench space of 24 in. by 30 in. and weighs 217 lb.

A HIGH POWER MULTIPLE SPINDLE DRILL

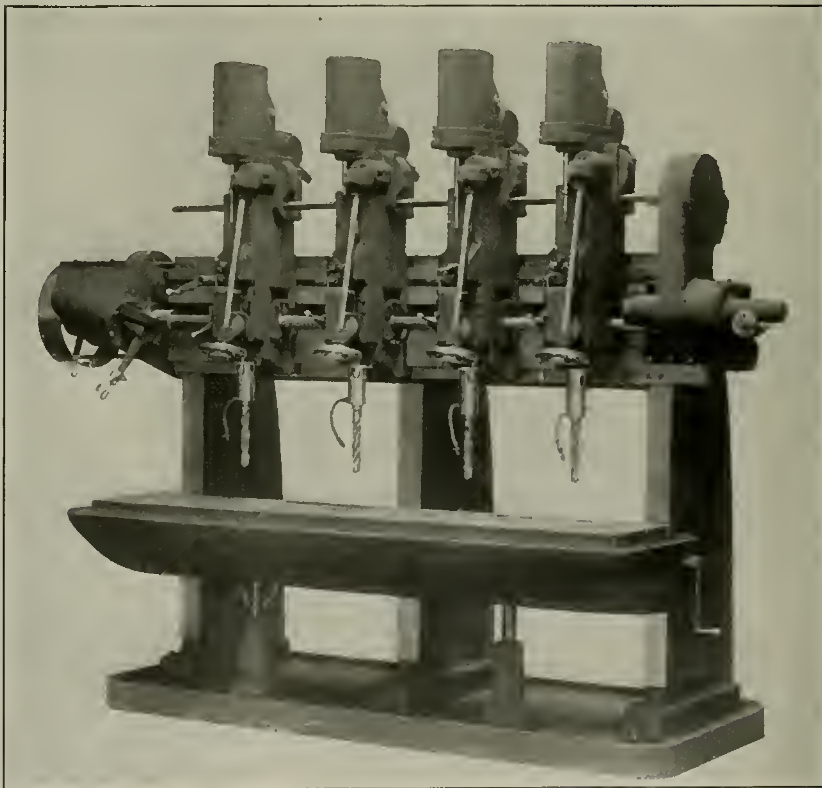
The multiple spindle drill shown in the illustration is a heavy service production tool especially intended for use in locomotive and railway shops and will be found useful where the work includes heavy gang drilling or heavy jig drilling. When used on jig work the compactness of this drill enables one operator to keep a greater number of spindles—either singly or in groups—continually in operation, and as a result the operator is kept constantly reloading the jig while some of the drills are kept constantly producing.

The speed mechanism is attached to the upper end of the upright at the left end of the frame and provides a range of six speeds from 25 to 186 r.p.m. It consists of two cones of hardened steel gears, back gears, and a hardened roll-in gear. There are three gears on each of the cones and these when used in conjunction with the back gears furnish the speed changes which are selected by sliding and dropping the roll-in gear into mesh with the various sets of gears on the cones. The shafts in the speed box rotate in Hyatt roller bearings, and the drive shaft, which transmits the power from the speed mechanism to the spindles, rotates in combined radial and thrust ball bearings. Power is applied to the speed box through a constant speed pulley and is transmitted through a Johnson friction clutch.

The feed mechanism gives three changes, namely, .006 in., .009 in. and .014 in. and is tightly encased and fastened to the upper end of the upright at the extreme right end of the frame. The changes are obtained through two cones of three gears each which are driven by the spindle drive shaft. Each of the two cones is fitted with three gears. The feed changes are effected by a slip key method which is operated by an indexed hand lever. The feed is transmitted from the two cones of gears to the feed shaft through miter gears and a worm and worm gear, with end thrust taken by ball bearings. A handwheel is also provided for quickly advancing or returning each spindle.

The minimum distance between spindle heads is 8 in. from center to center. The heads are gibbed to a heavy crossrail by a dove-tail method and are adjustable along the rail by means of a crank handle which operates a rack and pinion. The spindles are provided with No. 5 Morse taper and are driven by spiral gears. The spindle thrust is taken by S. K. F. ball bearings. The drive is located at the lower end of the head, which reduces torque in the spindle to a minimum. Each spindle is counterbalanced and can be driven and fed independently of the others. The levers used to apply the feed and drive to each spindle are interlocking so that the power feed cannot be engaged when the spindle is not being driven. Adjustable stops are provided automatically to disengage the feed when the holes have been drilled to a given depth.

The table, which affords a total working surface of 20 in. by 98 in. and a vertical adjustment of 12 in. by means of a crank handle which actuates two jack screws through a worm and worm gear mechanism, is a substantial box type casting. The jack screws supporting the table maintain its original alinement by receiving the trust of the



Multiple Spindle Rail Drill

cutting tools on the direct center line with the spindles. A cored section of the table serves as a reservoir for the cutting compound, and the table casting is shaped on all four sides so as to form a trough in which the cutting compound flows back to the reservoir. The pump which forces the cutting compound to the work is fastened to the upright at the left and is driven directly from the countershaft.

Lubrication is provided by a force feed, gravity flow and splash system combined, which is made possible by the all-enclosed unit construction. The speed mechanism, feed mechanism, and each of the spindle heads are provided with an independent and self-contained oiling system, which insures positive lubrication and economical maintenance.

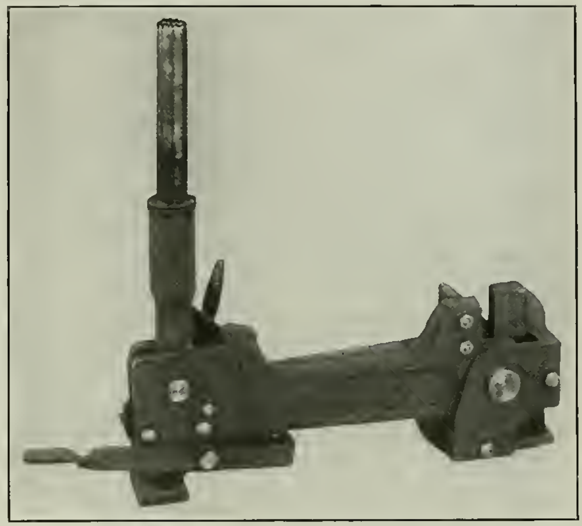
The contents of each unit are partially submerged in a bath of oil, while the bearings are lubricated by a force feed through individual leads which carry a sufficient flow of oil to flush all enclosed parts on its return to the reservoir.

The machine is operated by a 10-hp. motor, weighs about 15,000 lb. ready for shipment, and will occupy a floor space of 56 in. by 144 in. It is known as the No. 23 rail drill and is built by Defiance Machine Works, Defiance, O.

A POWERFUL HAND OPERATED BAR CUTTER

THE frame of the bar cutter shown in the photograph is of cast steel and is reinforced by heavy steel plates at the two main bearings; the cutter blades are made of specially treated tool steel in order that they may cut high carbon steel such as is in bars for reinforced concrete construction work.

The shear is fitted with a quick return arrangement which is made operative by throwing a pawl out of engagement by means of the short lever. The shearing blade may be brought into position quickly up to the point where the blade comes in contact with the bar to be cut by the use of a foot lever, whereas the actual cutting of the bar is only accomplished by operating the long lever and ratchet. The quick adjustment saves a great deal of time, as the ratchet operation is necessarily slow on account of the great leverage required to cut off heavy bars. The only spring used in this machine is one for holding the ratchet pawl out of engagement, in order that the movable cutting jaw may be returned to the starting position by its own weight.



Convenient and Powerful Bar Cutter

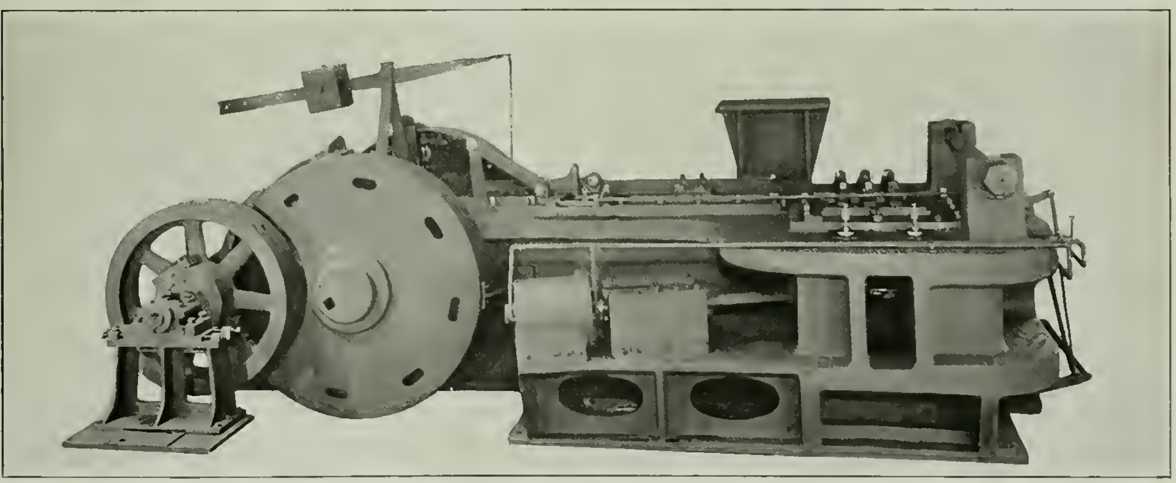
This bar cutter weighs 178 lb. and is light in comparison to its shearing capacity. It will cut square twisted reinforcement bars, or mild steel bars, cold, up to 1¼ in., round mild steel bars up to 1⅜ in. diameter, and flat mild steel bars ¾ in. thick by 3 in. wide. It is known as the Wallace No. 167 bar cutter, manufactured by the Wallace Supplies Manufacturing Company of Chicago.

The machine is 8 in. wide by 35 in. long and the lever, which consists of an ordinary piece of iron pipe, is 6 ft. in length. The height from the floor to the top of the cutting jaw is 11 in.

SPECIAL AJAX UPSETTING FORGING MACHINE

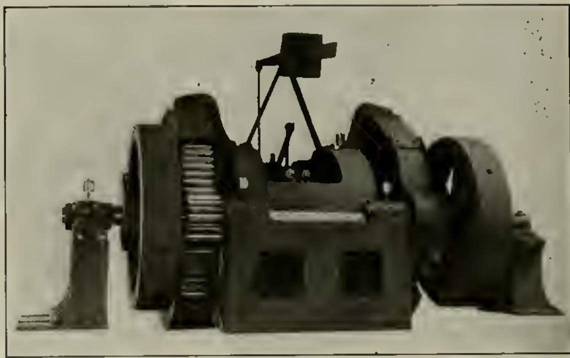
STERN necessity, under war conditions, forced many of the machine tool manufacturers quickly to develop new and unusual designs in order to assist the government in the production of munitions and supplies. As an example many interesting articles might be written on what was done in the manufacture of forgings, some of them of the most intricate designs and others of simple design but of unusual proportions. Fortunately, some of the special machines which have been designed and many of the lessons which have been learned may be applied to advantage under normal industrial conditions.

Many large forgings are required in the manufacture and



Side View of Ajax Upsetting Forging Machine with Extra Large Stock Gather.

maintenance of railroad equipment and doubtless an upsetting forging machine with an extra large stock gather, which was designed by the Ajax Manufacturing Company, Cleveland, Ohio, for making forgings required in the construction of artillery at the Ford motor car plant at Detroit, Mich., may be used to advantage for some of this work. This machine, which is shown in the illustrations, was so designed that an extra long stroke may be obtained after the gripping die has closed, thus holding the stock while the upsetting ram or tool performs its upsetting operation. The moving or gripping die is operated by an air cylinder and the heading tool or ram has a travel of 24 in. after the dies are closed. This stroke can, in cases of emergency, be increased to 26 in. The die space will accommodate a die 35 in. high and 27½ in. long. The crank shaft has a gear on either end, giving a double gear drive, thus protecting the shaft from torsional stresses. One of the views shows clearly the double gear drive with the two safety flywheels which are provided with safety shear pins. The crank is 13 in. in diameter.



Showing Double Gear Drive with Two-Safety Fly Wheels.

The air cylinder operates under 100 lb. pressure. The floor space occupied by the machine is 24 ft. by 15 ft. and the total weight of the machine is a little over 100 tons.

A NEW ANGLE ON MILLING MACHINES

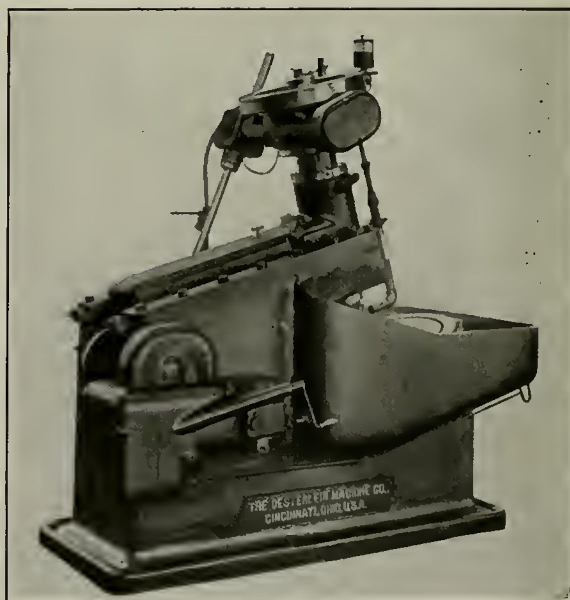
THAT there is apparently no limit to which the designer will go in the search for the practical application of every possible principle which will influence the efficiency of machine tool production, is strikingly illustrated in the tilted rotary milling machine shown in the illustration, in the design and construction of which will be noted an entire disregard for all precedent.

It is stated that the successful development of the Ohio tilted rotary milling machine, which will be exhibited at the June mechanical conventions at Atlantic City by the Oesterlein Machine Company, Cincinnati, Ohio, has produced a continuous production milling machine which has eliminated a large part of the idle time between cuts, has increased the rigidity by a reduction in the number of parts, and insures a sufficient supply of lubricant for cooling the cutters.

The usual time spent in returning a longitudinal feeding table, removing the finished work, clamping the new piece in the fixture and again bringing the cutter to the position for cutting, is obviated in this type; by the substitution of continuous milling, this time is converted into production time, with a consequent increase in the output per hour. This is accomplished by the rotary table which carries the work to the cutting position; during the cutting operation the finished work is removed at the opposite side of the table and new work is set up.

This continuous operation not only eliminates lost time, but it sets the pace for removing and setting up the work. The cutter may be held in a fixed position and the table rotated continuously by automatic feed for continuous milling, or the cutter may be reciprocated radially in combination with an intermittent motion of the table controlled by an indexing mechanism. This indexing mechanism provides for from 2 to 72 divisions and the table revolves rapidly between divisions, in order to reduce the idle time. By feeding the cutter radially over the surface of the work the loss of time between milling surfaces is avoided on such jobs as cannot be compactly spaced. Other advantages are that the nonproductive time of cutter approach is avoided, the cutter travels the shortest possible distance, two or more simple fixtures may be used instead of one large fixture, and the machine is practical when applied to small quantity lots.

The body of the machine is cast in one piece and no bolts, elevating screws or gibs are subjected to the load of the cut. The general lines of the machine may be said to resemble a punch press or shear. The working surface of the table and the cutter spindle are both contained in this body casting and the possibility of relative deformation under load of the cutter and work is avoided. As the body of the machine is directly under the circular table there is nothing to depreciate the anvil-like rigidity from the table bearing to the floor.



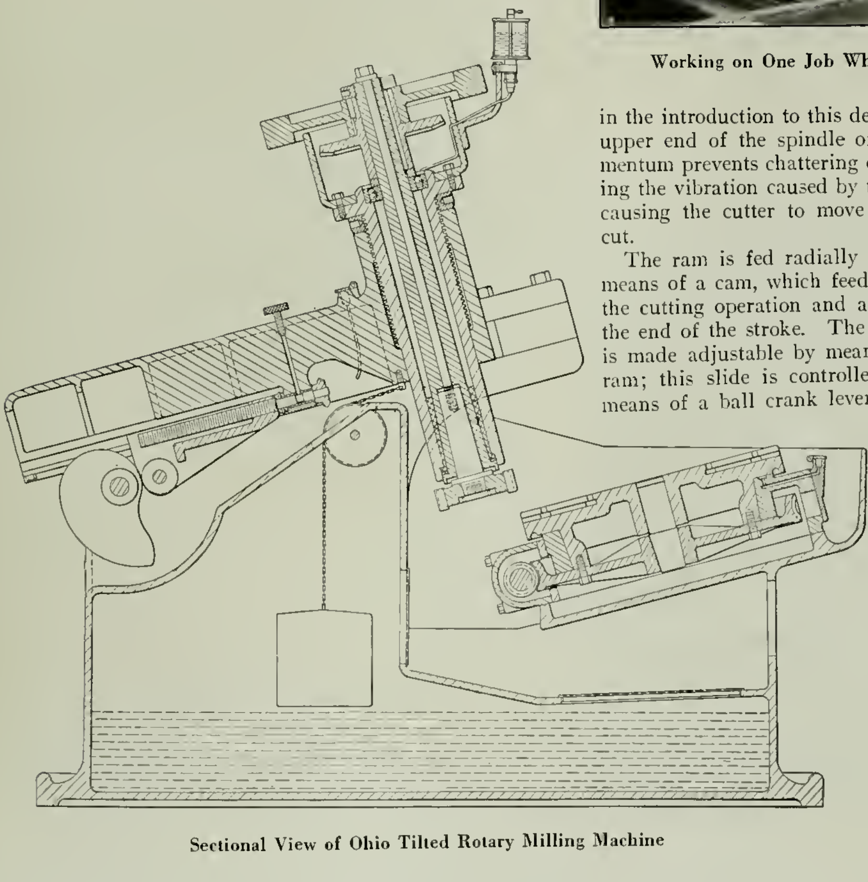
Ohio Tilted Rotary Milling Machine

There are no overhanging parts on the machine; the ram bearings are extended in front so that even in the advanced position of the cutters the full length of the ram is effective.

A worm wheel of 28-in. pitch diameter driven by a worm of 1¼-in. pitch and 4-in. diameter drives the 30-in. diameter table which is set at an angle of 150 deg. This worm wheel is set as close to the table surface as the taper table bearing will permit and is bolted and pinned to the table at the extreme end of the bearing; the central stud merely serves as means for alining the worm and the table. The latter is provided with two circular and four radial T-slots for the purpose of clamping the fixtures. The ram bearing has a surface of 1,000 sq. in. and three gibs permit of adjustment in all directions.

The machine is driven by a 4-in. belt over the pulley located on the side of the machine, either from a line or a jackshaft, or by a motor mounted on a special base plate placed on the top of the machine. Power for driving the spindle which carries a No. 16 Brown & Sharpe taper is transmitted from the pulley through mitre gears to an intermediate shaft which connects with the first change gear shaft in the speed box by means of a second pair of mitre gears. A single pair of change gears connect the first and second change gear shifts; "pick off gears" are used on the two shafts and give 30 spindle speeds, using 15 pairs of change gears.

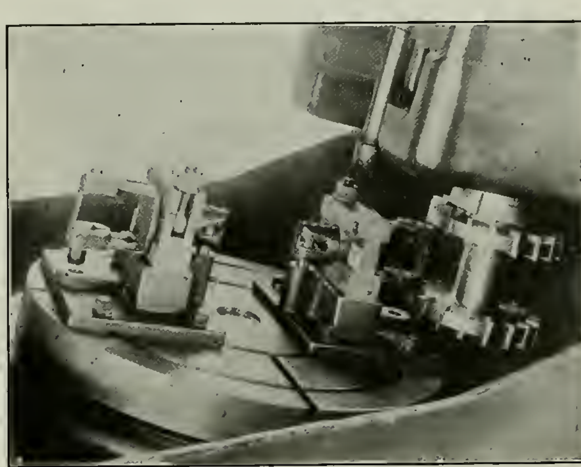
The intermediate shaft is made in two sections, which are connected by a coupling, by the releasing of which and turning the first change gear shaft through half a revolution, the opposite end of the upper half of the intermediate shaft couples with the lower section. This reverses the direction of rotation of the spindle and allows the use of either right hand or left hand face mills as desired. The intermediate shaft is splined at the upper end, and permits the pulley shaft and first intermediate shaft to trunnion, to allow reciprocation of the ram. Ball bearings are used wherever practicable throughout the driving mechanism.



Sectional View of Ohio Tilted Rotary Milling Machine

The spindle, which is adjustable vertically by means of a graduated collar, is carried in a sleeve, on the upper end of which is attached the speed box casting. The lower spindle bearing is 4½ in. in diameter and runs in a phosphor bronze bushing. The upper spindle bearing is a radio thrust ball bearing. A clutch in the end of the spindle provides for a positive driving of the arbors.

An example of one of the practical applications of principles which influence the efficiency of production referred to in the introduction to this description, is the mounting on the upper end of the spindle of a 250-lb. flywheel, whose momentum prevents chattering of the cutters as well as eliminating the vibration caused by the lacklash in the driving gears, causing the cutter to move smoothly into and through the cut.



Working on One Job While Another Is Being Set Up

The ram is fed radially over the surface of the table by means of a cam, which feeds the ram forward slowly during the cutting operation and allows it to drop back rapidly at the end of the stroke. The relative radial travel of the ram is made adjustable by means of a slide mounted under the ram; this slide is controlled from the side of the ram by means of a ball crank lever and is clamped by means of a knurled knob. A double row ball bearing serves as a cam roller.

The pulley shaft extends through the machine and drives the feed box mechanism; the operations of the feed box are controlled by a push rod extending along the side of the machine to within reach of the operator. The cam shaft is driven by a worm and worm wheel in the feed box. A four-gear feed change mechanism regulates the feed of the table when the continuous table motion is used or the rate of revolution of the cam when the indexing mechanism is used. The cutting feeds, therefore, are established by the ratio of these change gears. The index mechanism may be omitted for a machine on which only the continuous feeding table is desired, or the indexing mechanism may be added to a continuous feeding machine at any time. It should be noted that the feed change gears regulate the rate of travel of the ram and the throw of the cam regulates the length of travel of the ram. A crank operated shaft is provided so that the feed mechanism may be operated by hand when setting up or trying out a job. A lever is also provided for tripping the index mechanism.

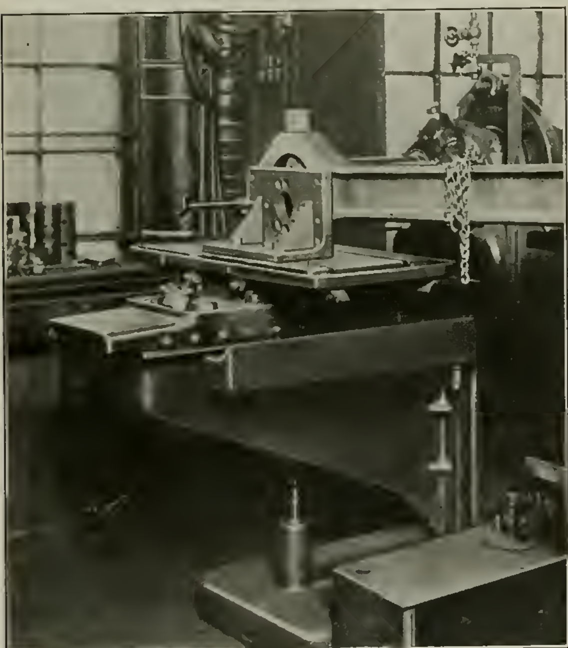
Lubrication is provided for by a pump of 35 gallons per minute capacity, attached to the side of the machine and driven by a belt from the pulley shaft. The lubricant is raised under pressure to a distance above the machine and expanded in a large pipe before it falls on the cutter and work; it drains from the chips which are deposited in a pocket provided in the base at the low end of the table, into a 60 gallon reservoir in the base. A large central distribution oiler on the speed box provides for speed box and spindle requirements and a similar oiler lubricates the pulley shaft. A central oiling point located at the top of the ram provides distribution to the ram slide and similar provisions are made for feed box mechanism and for the table bearings. Ample provision is therefore made for the lubrication of all parts.

THE INTERNAL GRINDER IN THE LOCOMOTIVE SHOP

THOSE who have benefitted by their recognition of the cylindrical grinder's place in the locomotive shop for finishing piston and valve rods, and crosshead and other pins will be interested in the internal grinding machine shown in the illustrations.

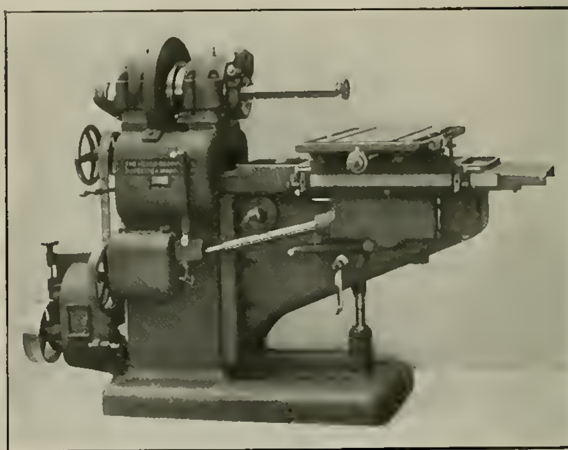
In repairing valve motion levers, parallel rods and various other similar parts, where the holes in the rods or in the bushings are worn oblong or rough, or the holes in the levers have become distorted, the use of this type of grinder will commend itself; these holes can be ground true and thus avoid the necessity for renewing the bushings or reaming the lever. Reaming would in some cases be the quicker operation, but it would not produce as true a hole and would result in enlarging the hole more than by grinding. On parts which have been warped in casehardening it is much easier to true the holes by grinding than by any other method.

Then, too, this machine may be used to good advantage on various air brake parts, including triple valves. The valve chambers in the top heads of air compressors when worn, may also be refinished on it. Steam and air cylinders may be refinished when worn or cut. To refinish a very badly worn cylinder may require more time than on a boring machine, on account of the large amount of metal to be removed in order to true up the entire surface, but even if this be the case, grinding will generally be the more economical when considering the life of the cylinders.



Trueing Up the Bushing Fit in a Side Rod

The article to be ground is secured to the table, which may be adjusted so that the work will be brought in line with the grinding wheel spindle. The illustrations show a No. 60 internal grinding machine manufactured by the Heald Machine Company, Worcester, Mass. This company expects to exhibit a machine of this type at the June mechanical conventions at Atlantic City.



Heald No. 60 Cylinder Grinder

Notable features of the machine are a large crosswise adjustment of the work, large vertical adjustment of the knee, multiple speeds for the rotation of the head, quick change gear boxes for speeds and feeds, and micrometer readings throughout.

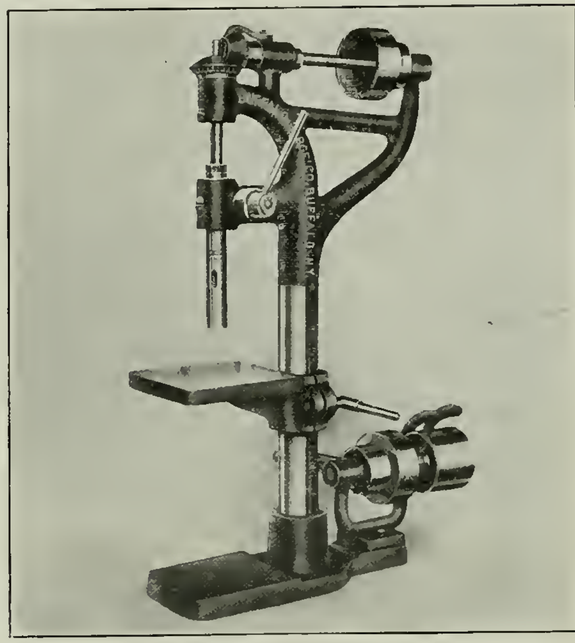
The proportions of this grinder, which occupies 38 in. by 90 in. of floor space and is driven by a 3-hp., 1,200 r.p.m motor, are well conveyed by the general photograph; another photograph illustrates the grinder performing a characteristic railroad shop operation in the grinding of an elongated bushing fitted in a locomotive side rod. The main table is 13 in. wide by 52 in. long, with a finished top 10 in. wide by 24 in. long, and has two T-slots and alining grooves. The cross slide table is 18 in. wide by 36 in. long, provided with a finished top 14 in. wide by 28 in. long, with two T-slots. The vertical adjustment of the knee is 3½ in. Micrometer dials are furnished for horizontal and vertical adjustments. Spindles regularly furnished with the machine will grind holes of three or more inches in diameter by 15 in. long; the standard grinding wheels used are 3½ in. and 4 in. in diameter by ¾-in. face, and are rated from 4,400 to 5,800 surface ft. per minute. The maximum distance of the finished pad on the cross slide table below the center of the grinding circle is 7½ in.; to the main table, 12 in.; the minimum distance is 4 in. and 8½ in., respectively.

A POWER BENCH DRILL FOR ACCURATE WORK

THE 10-in. power bench drill shown in the photograph is rather small for use in a railroad shop and yet there are places in the tool room or in other departments where it is desirable to have a machine of this kind for small and accurate work. The frame, excluding the base, is in one piece, simplifying the construction, and helping to keep the shafts and gears in perfect alignment. The machine will drill holes quickly and accurately up to 9/16 in. in diameter and to the center of a 10-in circle. The height over all is only 33½ in. and the machine weighs 110 lb.

The spindle is ¾ in. in diameter in the sleeve and has a travel of 3 in.; the column is 2½ in. in diameter; and the table measures 7 in. by 8 in. The greatest distance between the base and the spindle is 16 in., while the greatest distance between the table and the spindle is 9¾ in. The work table is adjustable up or down on the column or may be pushed to one side, thus allowing the base to be used as the table. The base is accurately planed and has countersunk bolts.

As may be seen, the upper cone pulley is supported between the bearings instead of being overhung, thus tending to balance the machine and relieve the frame from undesirable stresses. The countershaft is supplied with tight and loose pulleys and a belt shifter. The feed lever and spindle are held in position when idle by means of a friction spring, thus preventing the spindle from slipping down on to the work or the table. These drills are made by the Buffalo Forge Company, Buffalo, N. Y.



10-Inch Power Bench Drill

A NOTABLE ADVANCE IN GRINDING

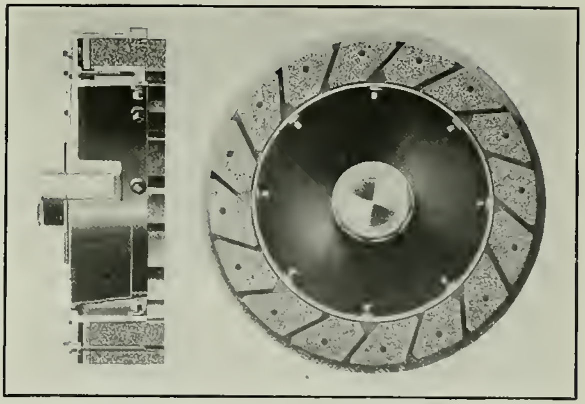
THE guide bar grinder illustrated herewith is noteworthy because of two significant steps forward in the development of large surface grinders. The basic improvement—a radical departure—is the grinding wheel whose chief characteristic is in its sectional or built-up construction. The origin of the design of this wheel emanated from an analysis of what happens between the wheel and the work, and practice is bearing out the value of the theory of a special provision for the regular and constant elimination of grindings and loose grit from the face of the wheel, which is achieved by the clearance between the blocks.

It will be seen that 16 blocks of the required abrasive material are inserted between the inner and outer flanges on the face of a carrying disk or chuck and are held in place through the adjustable pressure of wedges set in at the bases of the blocks and controlled by set screws and lock nuts through the inner flange, the combination forming a grinding wheel which is 32 in. in diameter.

The sectional view gives a clear idea of the manner in which the grinder blocks are controlled for lateral adjustment and shows the adjusting screws retained by collars at the back of the carrying disk, and screwed through the plates into which the grinding blocks are securely dovetailed. It will be noticed that sufficient adjustment has been provided to allow for practically the entire wear of the blocks. It is claimed that the sectional wheel will not "gum up," because it throws off through the grooves between the blocks the refuse from the wheel and the metal, which otherwise being unrelieved, imbeds itself in the face of the wheel, gumming it up, making necessary frequent redressing. Due to this chip relieving feature, it is stated that continuous fast and heavy grinding may be done with a sectional wheel of 4-in. width of face, where the limit of face for a solid wheel is usually 1½ in.

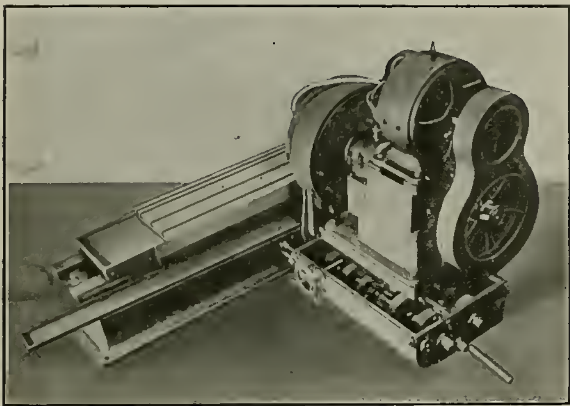
The grinding machine is heavy and rigid. The main bed is of cabinet base construction and supports a three T-slot carriage that travels back and forth on a flat track in front of the grinding wheel properly gibbed to take up wear.

Firmly bolted to this bed at the rear, midway between the ends, is a short back extension bed at right angles to



Showing Construction of Sectional or Built-Up Grinding Wheel

the main bed, with wide flat tracks on which a carriage is mounted, suitably gibbed, and arranged with a screw extending through the main bed, operated from the front side of the machine by a handwheel or by automatic feed, or by hand from the back of the machine, to bring the grinding wheel up to the work. On top of the carriage is a turret, pivoted at the center for grinding flat faces or by swiveling around to grind slight concaves as desired. The grinding wheel spindle is mounted on this turret and is 5½ in. in diameter, running in ball bearings both radial and end thrust, with adjustable take-ups for end wear, either forward or backward. The spindle is driven by means of a large spur gear which meshes into a wide faced fiber pinion on the shaft of the 25 H.P. motor mounted upon the turret.



Rear View Showing Application of Motor and Arrangement of Gearing

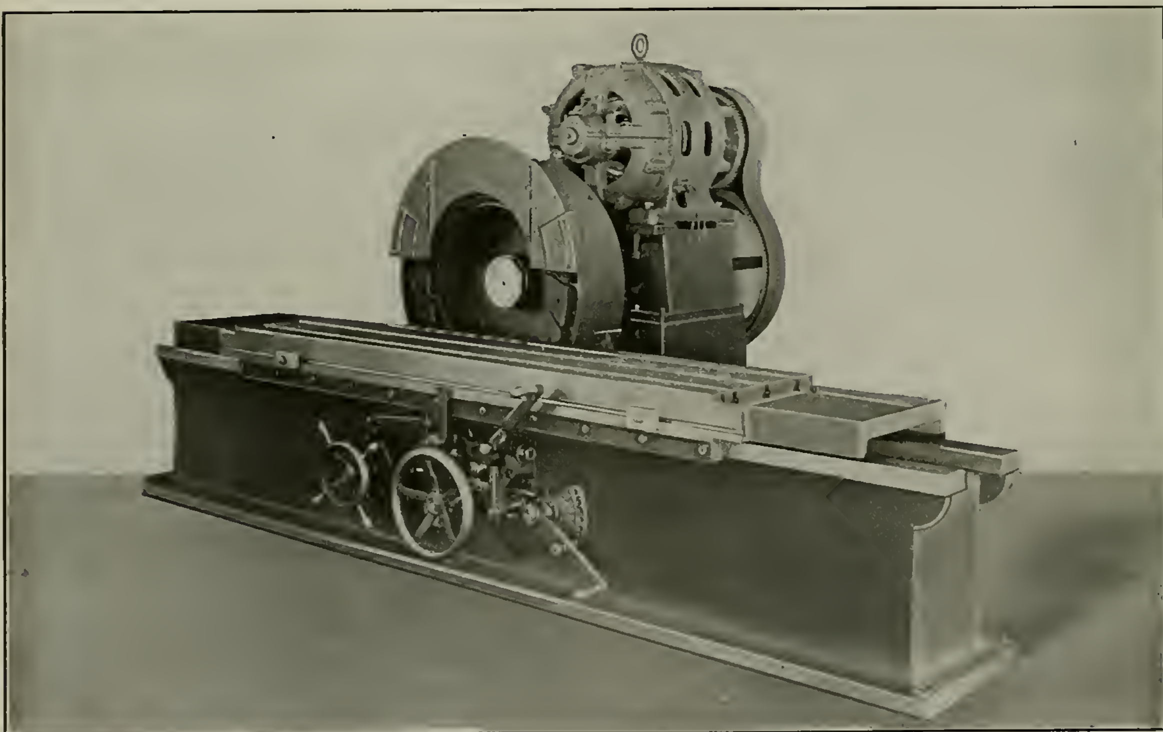
The second important feature in the machine is the multiple speed working table or carriage. For convenience in showing the location of change speed gears, which provide a carriage speed of 3, 6, 9 and 12 ft. per minute, respectively, the extension bed in which they operate is partly uncovered in one of the photographs. The desired speed is obtained by adjusting the speed control hand lever, shown at the right in the front view of the machine, in its proper position as indicated on the dial behind it. The lever is locked when in position for any desired carriage travel speed. The hand lever at the left in front of the machine is a carriage control and is locked in both working and neutral positions. There is a corresponding lever at the back of the machine for the convenience of the operator. The large hand wheel is for moving the carriage back and forth in adjustment to the work.

The dogs on the front side of the table may be adjusted for any length of travel up to the capacity of the machine. A centrifugal pump for supplying water to the grinding wheel is furnished with each machine. The front part of the back extension to which the pump is connected has a closed bottom, forming a reservoir. Drip pans on the back of the machine carry the water to the reservoir, thus using it over and over.

At the right and rear of the back extension are gear boxes with removable lids, allowing easy access to the working parts for oiling and making adjustments. One of the gears in the train of backgearing is a friction gear, arranged to slip under excessive load in case anything should get caught.

This machine, which should find many uses in railroad shops, particularly on the grinding of guides, is made in four lengths, 66 in., 86 in., 110 in., and 140 in., and ranges in weight from 12,330 lb. to 18,250 lb.

This sectional wheel guide bar grinder is manufactured by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn., who manufacture a general line of grinding machines of all types and sizes, the pioneer among which was one of the first grinding wheels regularly manufactured and sold under a safety slogan based upon the rigidity of its wheel guards.



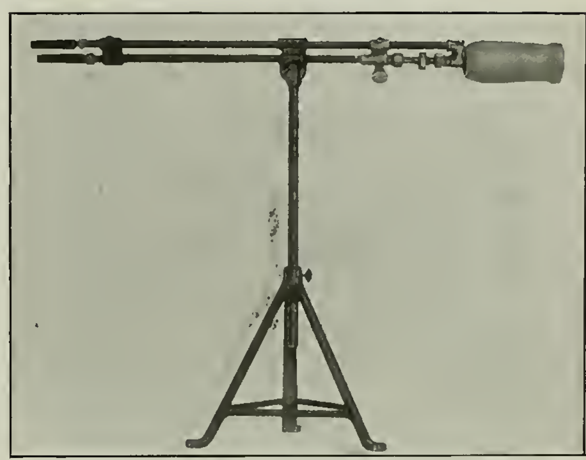
View of Surface Grinder From Operating Side

A KEROSENE TORCH FOR PREHEATING

A KEROSENE preheating torch has been perfected by Smith's Inventions, Inc., Minneapolis, Minn., which uses compressed air at about 40 lb. pressure, but requires no pressure on the kerosene. The compressed air in passing through the valve draws the kerosene with it and converts it into a vapor. This vapor, as it passes from the torch or nozzle, may be lighted instantly with a match without heating the nozzle. The flow of the kerosene is controlled by a separate valve and the torch flame may be made to vary from 6 in. to 4 ft. in length.

The nozzle shown in the illustration may be replaced by an elbow or other casting, thus deflecting the flame at a right angle or any other direction. The kerosene is drawn into the torch by simply dropping the end of the tube into a barrel or tank of kerosene.

The nozzle may be screwed off, in which case the torch may be used to spray the kerosene in cleaning motors, transmission cases, differentials, and for various other purposes. The adjustable stand is of simple and substantial construction and will be found specially convenient for many classes of work.

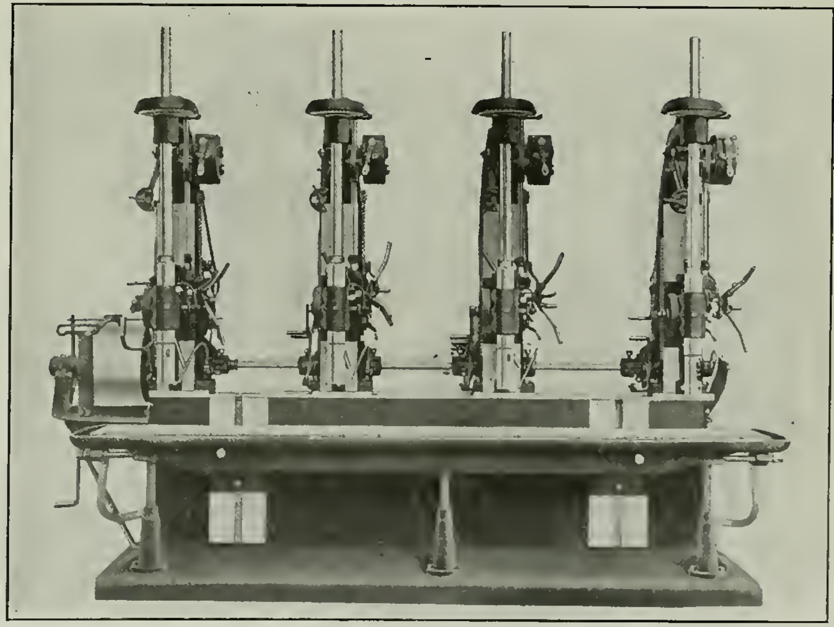


Kerosene Preheating Torch and Stand

TWENTY-SIX INCH ADJUSTABLE HEAD GANG DRILL

THE Barnes Drill Company, Rockford, Ill., has designed a 26-in. gang drill to permit a lateral adjustment of the spindles. In other respects the machine is similar to its standard line of all-geared gang drills. The spindle at the end of the machine nearest the driving pulley is fixed, but the three other heads may be adjusted laterally by means of rack and pinion. This provides a range in centers varying from 18 in. to 96 in. Each spindle will drill to the center of 26 in. and has a vertical travel of 14 in. The table, itself, has a vertical movement of 14½ in., while the sliding heads have a vertical adjustment of 23 in. The greatest distance from the top of the table to the floor is 36½ in., and the greatest distance from the spindle to the table is 37½ in. The table has a plain surface of 19 in. by 120 in., and the machine occupies a floor space of 51 in. by 138 in.

There are eight changes of geared speeds and eight changes of geared feeds on each spindle. The spindles operate independently of each other and all of the adjustments may be made by the operator from the front of the machine. The heads and spindles are counterbalanced, the weights being suspended by the roller bearing sheave wheels. The heads are gibbed to the column faces and may be securely held at any point by quick-acting screw clamps. Each head may be readily raised and lowered by means of a rack and pinion. An adjustable stop is provided which may be clamped on the column face in order that the sliding head may be brought back quickly to exactly the same place each time the head is raised, a most desirable feature.



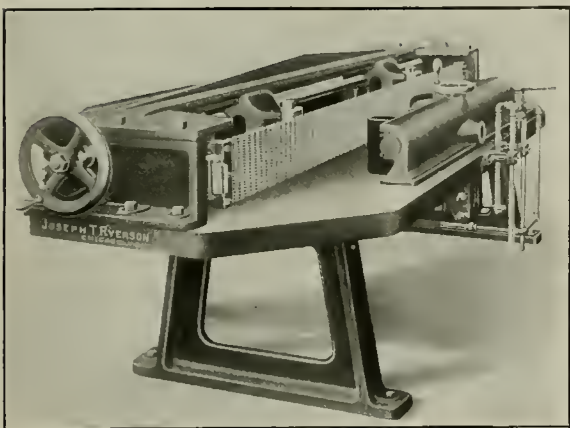
Gang Drill With Spindles Having Lateral Adjustment

A hand lever reverse is ordinarily provided but if desired an automatic reversing mechanism may be furnished. This is desirable for depth tapping; the trip may be set so that the instant the tap reaches the required depth the spindle will automatically reverse, backing out at an increased speed. The shifting lever may be so set that when tripped automatically or by hand, it will return to the neutral position, thus stopping the spindle instantly, instead of reversing it. The machine has a net weight of 9,700 lb.

UNIVERSAL ELLIPTIC SPRING FORMING MACHINE

UNTIL recent years, very little attention was given to the design of spring machinery for use in railroad repair shops. The greater part of the equipment in many shops was home-made and such machines as were available on the market were not designed from the viewpoint of operating the spring repair department as a unit. Joseph T. Ryerson & Son, Chicago, undertook the problem of developing a line of spring machinery specially adapted for railroad shops and with the idea of simplifying and co-ordinating all of the operations to as great an extent as practicable.

The latest addition to this line of spring machines is shown in the illustrations and is known as the Ryerson universal elliptic spring forming machine. It is made in four sizes and will form elliptic spring leaves of any size and curvature used in ordinary practice; it requires but one operator. This work in many railroad shops is now largely done by hand and the possibilities of the new machine in turning out more accurate and more uniform work at a considerably reduced cost are great. The hot spring leaf is formed upon a cold one against which it is to mate, thus giving it accurate camber and fit. A second heat for tempering is unnecessary as the leaf may be quickly passed from the machine to the tempering bath. The machine, when properly operated, will form leaves free from twisting or warping and will straighten out any twist that may be present in the original bar.



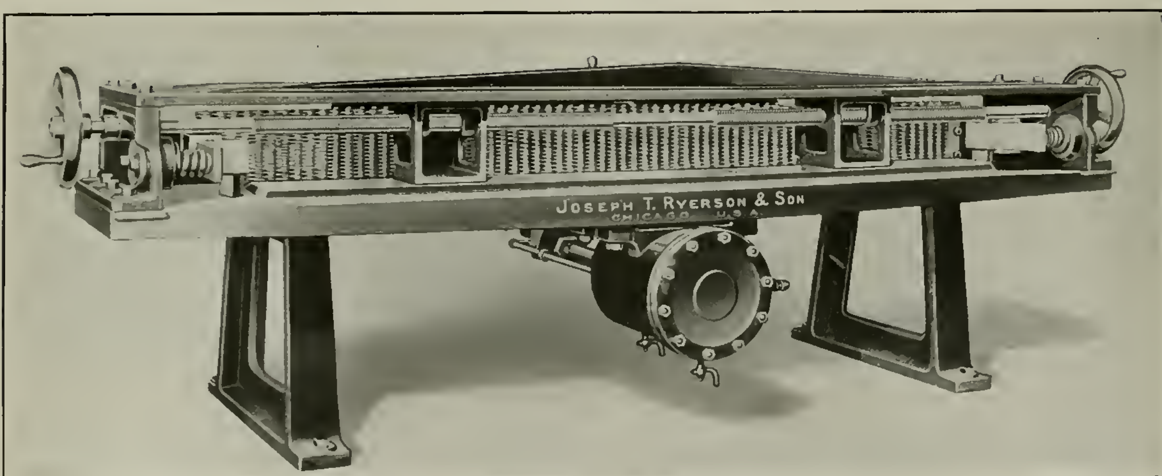
Elliptic Spring Forming Machine

One road which has installed a machine of this type was asked by the *Railway Mechanical Engineer* as to the results which had been obtained. Extracts from the report follow:

"Springs made by this method give more than triple the length of service compared with springs constructed by previous methods used in our shops. This means more continuous service from the locomotives so equipped because of less frequent spring renewals, less wear and deterioration to the locomotive because of the use of better springs, and a saving of wear to the track. All of this is reflected in increased mileage of the locomotives. The improvement is presumably due to the fact that the leaves are made more rapidly, at lower temperatures, permitting them to go to the spring baths at more uniform temperatures, and that the plates are fitted together more accurately so that each does its proper proportion of the work.

"The springs are not going back to the spring shop for repairs as frequently as they did formerly; for instance, a tye of spring used on a heavy Pacific locomotive was given careful study. An average of 38 of these springs were being made each month before the introduction of the spring forming machine. After the machine was introduced, the rate of manufacture of these springs dropped until it finally reached four per month, indicating conclusively the greater length of life due to the new method. It does not overstate the fact to say that springs made by this method have an increased life three times that of springs made by the best methods previously used."

The machines range in weight from 3,250 lb. for the smallest size to 4,000 lb. for the largest one. A special foundation is not necessary with this comparatively light weight, particularly since the machines are free from vibration in operation. What is known as the crosshead former is operated back and forth on the table by means of compressed air or hydraulic power through the cylinder attached underneath the table. The plunger is connected to the lower end of a vertical slide lever, the upper end of which is attached to the crosshead former. This provides for a maximum stroke of the former of 10¾ in. The three-way valve,



Rear View of Elliptic Spring Forming Machine

which controls the operation, is conveniently located for the operator.

There are three projections on the inner side of the crosshead former; the two outer ones are adjustable lengthwise to suit the length of the spring leaf and the central one may be adjusted crosswise with the table to suit the curvature of the leaf. The adjustments to suit the different leaves may be made quickly by means of a hand wheel.

In actual operation the cold leaf, against which the new one is to be formed, is placed next to the crosshead former and the hot leaf is placed just inside of it, the leaves being centered by nibs. When pressure is applied, the crosshead former forces the hot leaf against a metal chain forming band which rests on edge on the table top and is securely held in position by a double set of springs which furnish the necessary resistance to forming the spring plates. Directly back of the chain forming band is a set of what are designated as "laterally adjustable lengthening anvils." These anvils or formers may be adjusted lengthwise with the table by means of hand wheels at each end of the machine and provide means for lengthening or shortening the effective length of the metal chain to accommodate any length of spring plate and to form perfect contact at each end of the plate. They are quite clearly shown in the rear view.

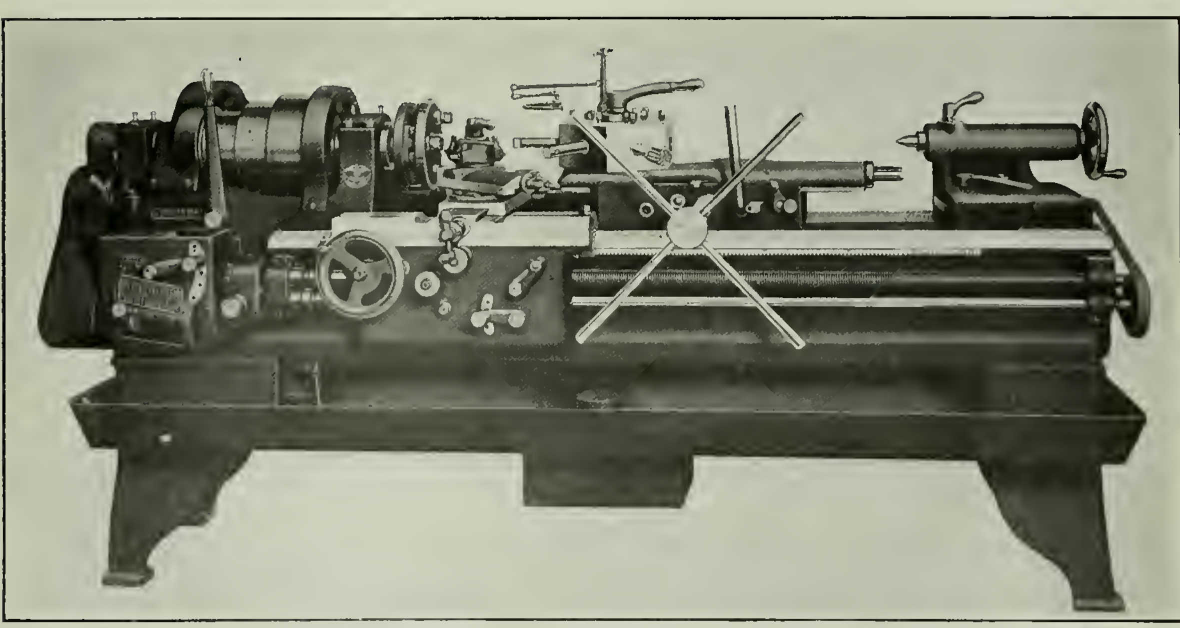
After the newly formed leaf has been dipped in the tempering bath and cooled, it is used as the cold plate for forming the next leaf, this being done successively until a full set of leaves is built up, after which they are assembled and banded. To provide the necessary camber for the hot leaf, the adjustable dies on the crosshead former are set to spring the cold template the desired amount, thus causing the radius of curvature of the new leaf to be reduced sufficiently to provide the desired camber.

The four sizes of machines differ principally as to the length of the table, this being such as to provide capacities for four sizes of spring leaves as follows: 5/8 in. x 7 in. x 60 in., 5/8 in. x 7 in. x 72 in., 5/8 in. x 7 in. x 84 in., and 5/8 in. x 7 in. x 96 in. The floor space required varies from 4 ft. x 9 ft. 6 in. for the smallest size to 4 ft. x 12 ft. 6 in. for the largest one.

CONVERTIBLE HEAVY ENGINE AND TURRET LATHE

Circumstances frequently arise in railroad shops where a heavy production turret lathe is called upon to perform somewhat spasmodically. It may stand idle for a period during which an expected order for 100 or 1,000 pieces, all of one kind, is not forthcoming, thus putting the "quantity producer" on a more or less non-dividend paying basis in proportion to the time it may actually be inoperative.

A suggested reliever of situations of this kind is offered in the design and construction of the severe duty engine lathe shown in the illustration, which provides all of the advantages of a heavy all-round engine lathe and at the same time can be quickly rigged up for quantity production by the attachment of a quick-acting hexagonal turret on the lathe bed and a turret tool holder on the cross slide.



Cincinnati Standard Engine Lathe With Quick-Acting Hexagonal Turret.

These lathes are all constructed to permit the addition of a taper attachment which is mounted on the carriage and has a long bearing on the lower side, insuring accuracy. Graduated on one end in degrees and on the opposite end in inches, this accessory will accommodate work up to 12 in. long in one setting and turn up to 10 deg. and 4-in. tapers per foot. This lathe is the product of the Cincinnati Lathe & Tool Company, Oakley, Cincinnati, Ohio, and is made in sizes from 16 in. to 28 in., inclusive, in either cone type belt drive, or geared head for belt or motor drive, with 2-ft. variations in length of bed from 6 ft. to 20 ft.

The headstock is made in three styles—four-step cone, single back gear; wide three-step cone, double back gears; and double friction back gears. The spindle, of high carbon forged steel, has a collar at the nose end supplying a stiff bearing when chucks and plates are attached. The thrust bearing at the rear end of the spindle provides a hardened tool steel collar for adjusting the wear; the end thrust is taken against the front end of the rear box.

The apron is of box type construction, giving a double support to all shafts and studs mounted in it, and providing for accuracy as well as long life of all the working parts. The rack pinion is made of steel, well supported close to the rack on the bed, and motion to it is transmitted by compound gearing. Longitudinal and cross friction feeds can be started, stopped or reversed while the lathe is running, but cannot be engaged when cutting screws. A thread chasing dial is provided, which permits the half nuts to be opened, the carriage to be run back by hand and the thread to be caught or picked up at any point without reversing the lathe, so that a backing belt is unnecessary. The machine is also provided with an automatic stop.

The reverse plate for cutting right and left hand threads is on the outside of the headstock and is used only for reversing the lead screw when cutting threads and not for reversing the feed. These machines have feed reverse in the apron. A device with a quadrant permits a combination of extra or metric pitches with U. S. standard lead screw, or vice versa, besides those obtained in the gear box.

The screw cutting and feed mechanism is characterized by its simplicity, compactness, ease of manipulation and strength. Changes from one standard thread to another can be made at once without duplicating or removing a gear, by simply operating two levers conveniently placed a few inches apart. The index plates are so placed on the box that the operator will know at a glance the correct setting for any thread or feed.

The tailstock is of the offset type, which allows a compound rest to be set in a plane parallel with the bed.

TWENTY-INCH AUTOMATIC TURRET LATHE

Not a few railroads now have manufacturing departments in their larger shops for quantity production of small standard parts. The automatic turret lathe occupies a prominent place in such departments.

The 20-in. automatic turret lathe shown in the illustrations has been designed to be convenient in adjustment, rigid and powerful in use, and all of its motions and operations are automatic except the insertion and removal of the work; even the automatic removal of work may be accomplished on some pieces if an air chuck is used. It has turret feeds ranging from .003 in. to .333 in. and cross slide feeds ranging from .0015 in. to .166 in. per revolution of the spindle.

Safety to the operator has been given special attention. The gears have been covered and all revolving parts protected. Dangerous projecting parts have been eliminated. and the turret has been designed to turn toward the front, instead of in the usual way, so as to protect the operator and avoid the danger of the tools catching him and drawing him against the machine. The lathe has an over-all length of practically 12 ft., with a maximum distance from chuck to turret of 48 in. It is built for either belt or motor drive by the Gisholt Machine Company, Madison, Wis.

When the shape of the work permits, it is possible to arrange the chuck jaws so that, after the piece has been finished on one side, it may be reversed in the chuck by the operator and the other side finished with tools mounted on the remaining faces of the turret.

Either standard 18 in. scroll chucks, or air chucks may be used with these machines. When an air chuck is used, the pressure is automatically controlled by a valve operated by a dial below the pulley shield, so that in taking roughing cuts a maximum air pressure of about 80 lb. or 90 lb. is used, but when taking light finishing cuts, this pressure is reduced to 20 lb. or 30 lb., to relieve the strain and prevent distortion of the part that is being finished. The dial mentioned above also automatically controls the electric signal,

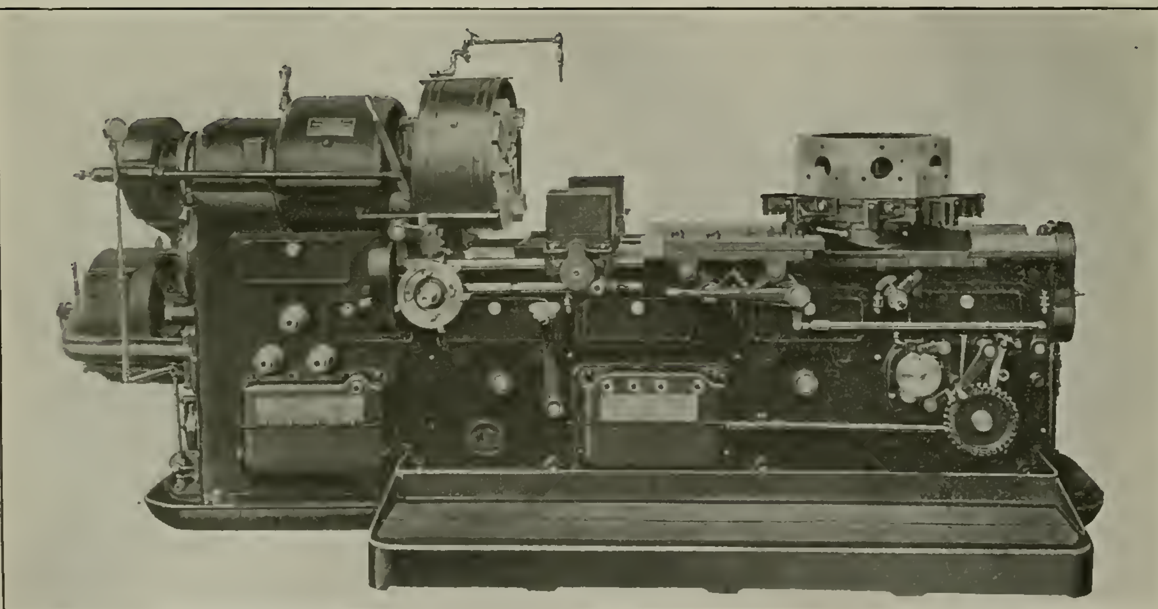


Fig. 1. 20-in. Gisholt Automatic Turret Lathe

which notifies the operator when the piece is completed. The air cylinder is operated in either direction, by a lever conveniently located, and is adapted for either internal or external chucking, without any adjustment of cylinder or chuck, except the provision of proper top jaws on the chuck

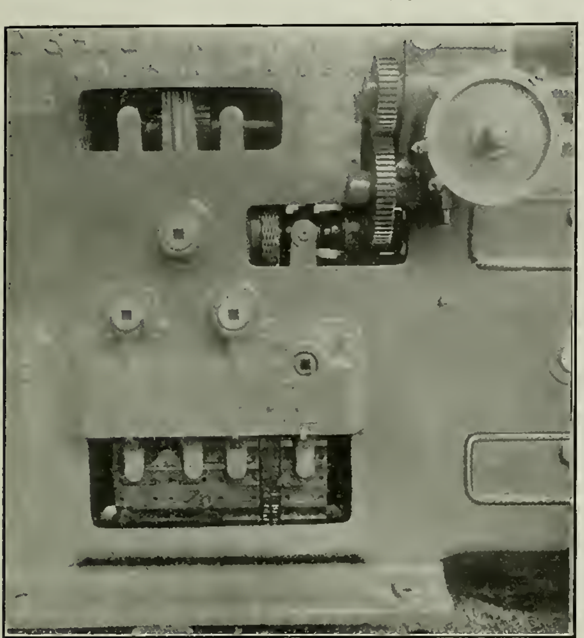


Fig. 2. Drum Blocks Which Control the Spindle Speeds

cross feed screw, lead screw and the like, are provided with jaw bases. A positive spindle brake is provided for the convenience and safety of the operator when chucking.

The machine, as a whole, is constructed on the unit principle. The main driving shaft runs from end to end. All

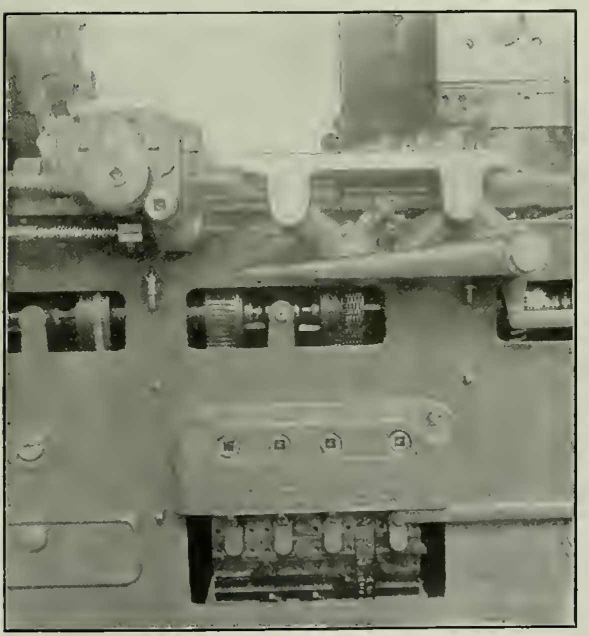


Fig. 3. Drum Blocks Which Control the Feeds and the Traverse Movement of the Turret and the Cross Slide

shafts for headstock and turret-drum levers, as well as the square socket holes, of uniform size, so that one hand crank can be used for convenience in setting up for a job.

The spindle bearings have ring oilers and all fast running shafts have sight-feed oilers. There are four changes of spindle speeds running in geometric progression. All spindle speeds are obtained through friction clutches by the operation of two levers, automatically controlled by blocks on a drum underneath the headstock, as shown in Fig. 2. By the use of these blocks, with the assistance of the pointers

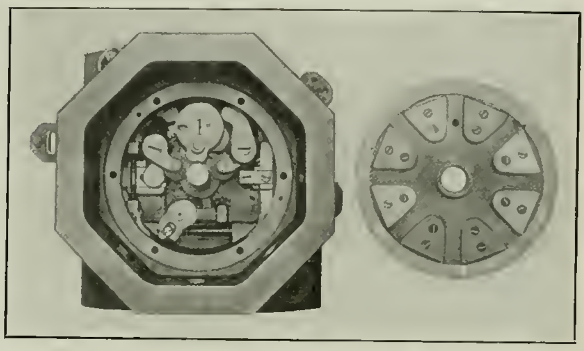


Fig. 4. Inside of Turret Indexing Mechanism

and speed tables shown, the shifting levers are easily set for any available speed.

Thirty-three feeds obtained by change gears are available for feeding the cross slide in or out, or for feeding the turret forward. The independent trip blocks for the in and out cross feed, are shown on the dial under and a little to the

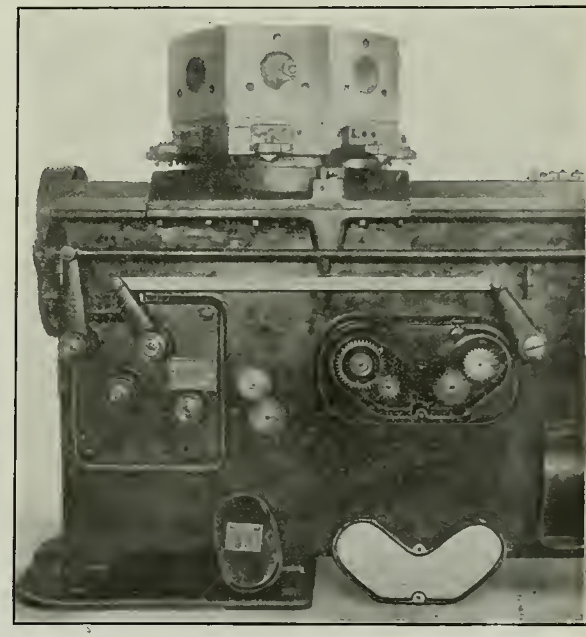


Fig. 5. Rear View Showing Covers Removed from Change Gears

left of chuck in Fig. 1. Rapid traverse movement in either direction for the cross slide and turret are also provided. The feeds provided are suitable for roughing, finishing, reaming and facing. Any feed is available for the tools on any face of the turret, or for either the front or back tool block on the cross-slide by applying the proper drum blocks on the drum shown in Fig. 3. These drum blocks also control the traverse movement of the turret and cross slide.

The turret has independent trip blocks for each face, which strike blocks on a trip table, as shown in Fig. 1. This photograph also shows the convenient position of the hand-tripping lever, just below the trip table.

The headstock and turret drums referred to, are provided with 31 spaces, making 30 changes possible, with one space for starting. When all the spaces are not to be used the front row of studs on the outer diameter of the index dial rim which is shown near the lower right-hand corner of Fig. 1 causes the drum shaft to be brought rapidly back to zero, or the starting point, for the chucking of the next piece.

The rear row of studs on the outer diameter of the index dial rim is used to set the timer in motion, the speed of which is controlled by gears interchangeable with the feed change gears. These change gears give the timer a speed of from 2.9 to 6.4 revolutions per one revolution of the spindle. The purpose of the timer is to give a "clean up" or "dwell" period for any feed of the turret or cross slide for any predetermined number of spindle revolutions. It may also be used for stopping any feed after a certain number of revolutions of the spindle. After completing a "dwell" or "feed period" the timer automatically trips the machine for the next operation. The timer dial is shown in Fig. 1 a little above and to the left of the index dial.

The row of studs on the side of the index dial next to the bed of the machine is used for setting the brake on the turret lead screw during a "dwell" or "clean up" cut, thus preventing the tool from being forced away from the work.

A desirable feature, to which attention should be directed, is the easy removal of the "index dial," "cross feed dial," and the "turret stop table," with all stops assembled. This feature makes the "setting up" of various jobs on the same machine very convenient in that it preserves the relative positions of all the stops for any particular job.

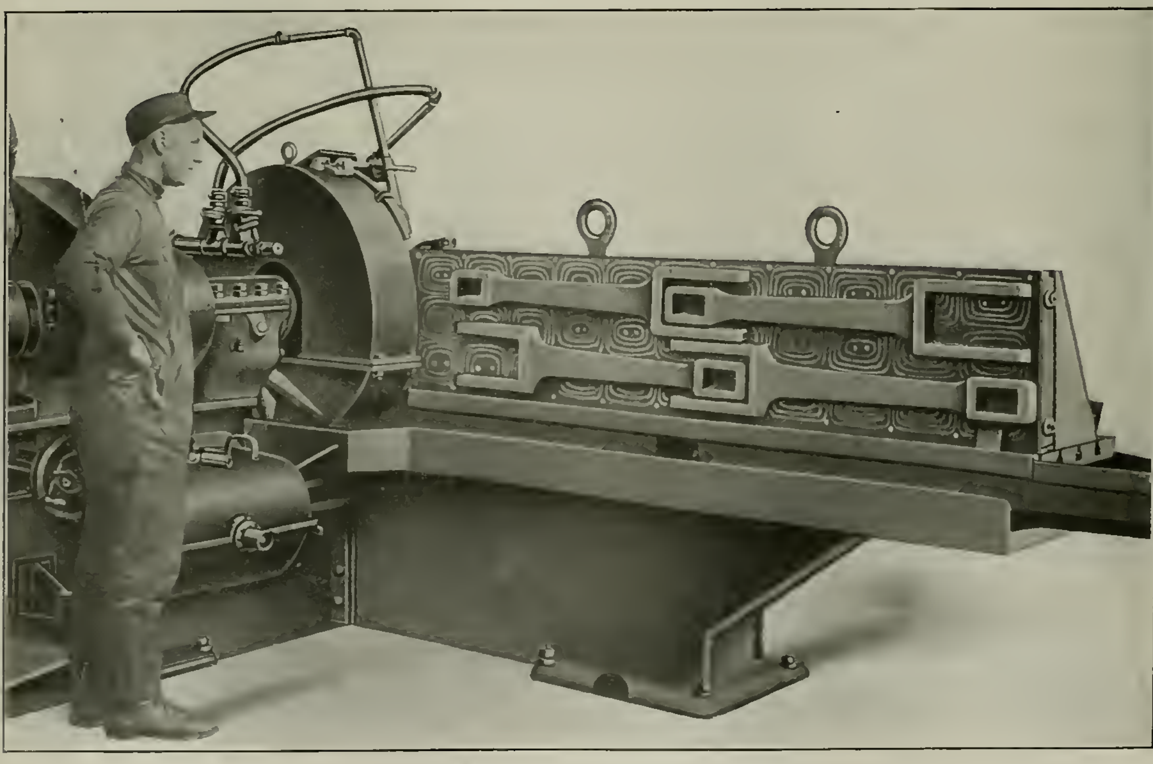
The inside of the turret indexing mechanism is shown in Fig. 4. In order to expose the indexing and locking mechanism the top plate is shown removed and placed bottom side up to the right of the turret. From this it will be seen that the turret is revolved by a crank movement, a roller on the end of the crank working in the spaces between the blocks which are doweled and screwed to the bottom of the turret as shown.

In order to give an idea of the placing of the change gears a part of the back of the machine is shown in Fig. 5, with the gear covers removed. The gears are easily slipped off or on by hand.

CUTTING DOWN THE CHUCKING TIME

IN keeping with the steady progress in the use of the individual electric motor drive for machine tools in railroad shops, the acquisition of electrically operated accessories and small tools is receiving much consideration. The large magnetic chuck shown in the photograph is offered as a suggestion in the chucking of parts for face grinding.

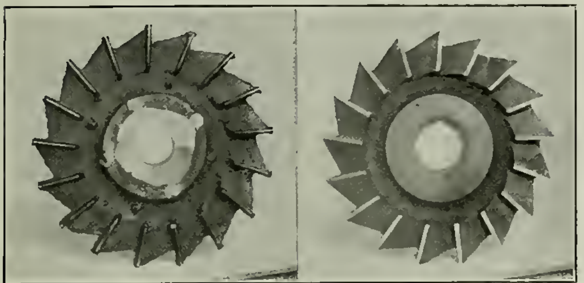
The face of the chuck is 18 in. by 84 in. and is shown in operation bolted to the bed of a heavy duty face grinding machine manufactured by the Diamond Machine Company, Providence, R. I. The four connecting rods are being ground



Grinding Machine Equipped with Magnetic Chuck from the rough without any previous machining. The question immediately arises as to how the work is held magnetically in view of the unevenness consequent to the rough forging, and in view of the fact that at the start of the work the links will not be held by a smooth surface. The answer is that a very light cut is taken from the surfaces in the rough and then the links are turned over so that the fairly smooth surface is against the magnetic face.

REMARKABLE DEVELOPMENT OF CAST TOOL STEEL

The perfection of a method of casting all-but-finished machine tools devoid of blow holes, crystallization, or strains, providing a homogeneous casting throughout with remarkable metal removing ability, seems to have been successfully achieved. A varied collection of steel tools and tool steel, manufactured under the Davidson process of casting formed tools, will be exhibited at the June mechanical conventions in Atlantic City by the exclusive distributor for the railroads in the United States, Oscar F. Ostby & Co., Inc., New York.


(Left) Rough Casting of Milling Cutter. (Right) Finished Cutter.

The story of the development of the process by Arthur C. Davidson, president of the Davidson Tool Manufacturing Corporation, New York, who has had a wide experience in the production and heat treatment of tools for different purposes, is a romance in steel making interrupted by discouragements, disappointments, accidents and the usual setbacks incident to the development of any revolutionary process.

In April, 1918, Mr. Davidson had no works of his own and it was necessary to rent a furnace which had at one time been used for making crucible castings, but which had been out of use for some months. This furnace was of poor design and in a bad state of repair, but it was thought that it would serve for a demonstration heat. Ten 100-lb. crucibles were accordingly charged and put into the furnace, one of which was charged entirely with high speed steel scrap, largely that resulting from previous melts made by Mr. Davidson. This was done to prove whether or not the gates and risers resulting from the casting operation, could be worked up in subsequent heats, with the object of gaging the value of the process if these had to be thrown away.

The furnace worked so badly that the heat instead of coming out in six hours, as it should have done, was in the furnace about ten hours, and only three pots became hot enough to pour at all, the metal even from these being entirely too dull for the best results. After this number had been poured, the cover over the furnace flue collapsed and the heat had to be terminated. The conditions surrounding the test were therefore in every way unfavorable and disadvantageous. Nevertheless a number of milling cutters, countersinks for ship rivets, and forming tools were cast, some of the best of them coming from the pot charged entirely with scrap. Two of the cutters and one of the countersinks were taken from the works, etched with private identification marks, turned back to Mr. Davidson for annealing, machining, hardening and grinding and were then tested. In order to have a fair standard of comparison, a side milling cutter of one of the best brands of high speed steel was bought directly from the works. The tests were made at the Quintard Iron Works, and although it was by no means a perfect casting, nevertheless it stood up favorably against the stock cutter under the most extreme test that could be given it.

A 2½-in. by ½-in. side milling cutter of the cast steel was then put in the machine and tested at gradually increasing speeds until finally the limit of the machine was reached. The cutter was taking a depth cut similar to a keyseat in a bar of steel of 0.30 or 0.40 per cent carbon, this cut being the width of the cutter by ¼ in. deep. On the final test, the cutter was run at a speed of 400 r.p.m., with a feed of 7 in. per minute. This is a linear cutting speed of about 250 ft. per minute, and, as stated, was the limit of the machine. The cut was run as far as the clamps on the test bar would permit, and as it was not possible to test the cutter any more severely, the trial was stopped, the cutter taken out, and it showed no sign of the gruelling test.

In spite of the fact that the casting conditions were bad, the results of the test seemed to indicate the probability that tools could be produced by this process free from blow holes and sufficiently true to form to be finished merely by grinding the cutting edges.

The structure of the steel appeared to be so good and the tests were so satisfactory that Mr. Davidson was advised to proceed with the commercial development of the process, and accordingly a small foundry was obtained in Brooklyn, N. Y., a crucible furnace built, molding machines, and machine tools for finishing or partially finishing the product installed, and production, which was started in August, has proceeded regularly ever since. An electric furnace has since been installed for melting the steel.

For convenience of comparison, an ordinary milling cutter, just as it comes from the mold, is shown in the illustration; adjoining it is shown the same cutter, ground and finished and ready for work. It will be noted that the milling cutters are cast with a projecting lip on the cutting edges; these are finished entirely by grinding and with little more expense than the grinding of a machine tool. A perfect edge is obtained in this way with a minimum of labor and lost steel, while the possibility of local defects is avoided.

The material used for "killing" the steel during the casting process is a secret; it may be said, however, that the results are striking in the last degree, and the metal, instead of having a comparatively sopey pour, is thin and fluid, more like good hot cast iron than like steel. As a result the details of small cutters are cast practically perfect.

It is well known that most steel, when cast, has a coarsely crystalline structure, but an examination of the fresh fractures of Davidsonized steel shows that this is almost wholly absent; in fact, the structure of this steel, as cast, looks more like that of forged steel than it does like a casting.

Davidsonized high speed steel milling cutters have machined chrome vanadium *D* type, showing scleroscopic reading of 40 points at 98 ft. per minute, depth of cut ⅜ in. and a feed of 6 in. per minute. They ran continually without grinding for six hours, after which it was only necessary to stone up the edges, after which they were run under the same conditions for eight hours. The teeth then required grinding of .005 in. off the diameter.

UTILITY STEAM OR COMPRESSED AIR HAMMER

WHAT is known as a 30-in. Cincinnati special forge operated either with compressed air or steam, has been developed by the Sullivan Machinery Company, Chicago, Ill., for such work as the making of chisels, wrenches, small tools of all kinds, small levers, keys and wedges, etc. It may also be used for welding and straightening rods and bolts, or for the sharpening of picks and crowbars, or similar jobs. An important advantage is its rapidity of action which is made possible by the use of an air or steam thrown valve; a maximum speed of 600 strokes per minute is possible.

The guide block is bolted to the rigid cast iron frame and supports a small vertical engine, as shown in the photograph. The small pin which is shown projecting from the lower end of the valve chest is held up, when the machine is not in operation, by the levers which are operated by the foot treadle. The upper part of the pin projects into the valve chest and abuts against the lower end of a floating valve. When the treadle is depressed, the end of the lever drops away from the pin and allows it to fall away from the valve. This uncovers the ports and the valve starts operating, and the hammer begins to strike. A single blow may be struck or many in succession, either light or heavy, at the will of the operator. The operation of the valve is similar to that of a rock drill valve; indeed, the hammer part of the machine is a Sullivan FF-12 rock drill.

Since the travel of the foot treadle is long as compared with the travel of the valve, the operator can feel out the action of the valve and closely and accurately control the action of the hammer. Because of the rapidity of action, the operations may be performed at a moderate heat.

The distance from the center of the die across the throat to the frame is 15 in. Work may be done upon material up to 2 in. in thickness. The hammer cylinder is 2⅝ in. in diameter and has a stroke of 5¾ in. The air consumption at 90 lb. per sq. in. pressure, is 93 cu. ft. per minute. The rebound of the hammer is controlled in such a way that some of the air or steam is held in the upper end of the cylinder, thus cushioning the piston on the return stroke, or rebound, and preventing a jar or jolt to the machine.

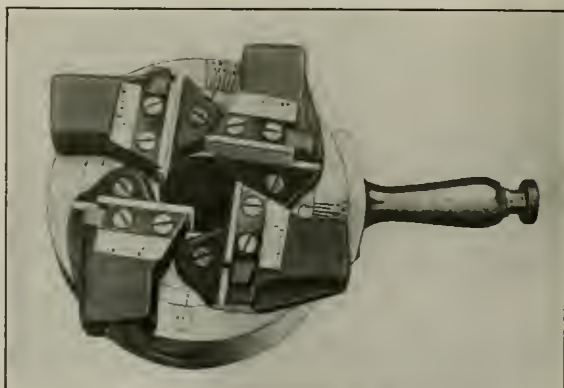
The weight of the striking parts is 100 lb., including 52 lb. for the upper guide, 27½ lb. for the upper die and 19 lb. for the weight of the piston, rings and springs. The machine has a net weight of 1675 lb., a height of 6 ft. 6 in.; the base is 26½ in. wide and 29 in. deep. The use of compressed air in operating the hammer has an important advantage in that the exhaust air may be utilized to blow chips, scale or dirt from the face of the die.

Power Hammer for Small Work

AUTOMATIC SCREW CUTTING DIE HEAD

ACCESSIBILITY is the keynote of the screw cutting die head shown in the photograph. The thread chasers which can be easily and quickly removed for grinding or changing, are supported on the face of the head. The head is opened automatically by retarding the forward motion of the carriage, is closed by hand, and is locked by the operating handle which contains a latch having a tongue milled on the lower end. This tongue is milled off center, thereby permitting of roughing and finishing cuts; to adjust the head for either merely requires a half turn of the latch to suitable graduations.

The head is graduated for all sizes of bolts and pipe, both right and left hand, within its range. It is adjusted to size by means of an adjusting screw which engages the head body. Since the operating, adjusting and closing rings remain in a fixed position when the head is closed, the rotating of the head body within these rings gives the diameters within the range of the head. To set the head for left hand threading,


Landis Automatic Die Head

the screw which locks the latch pin is removed and the latch pin is rotated to the left hand graduation; the locking screw is then replaced and the left hand holders attached.

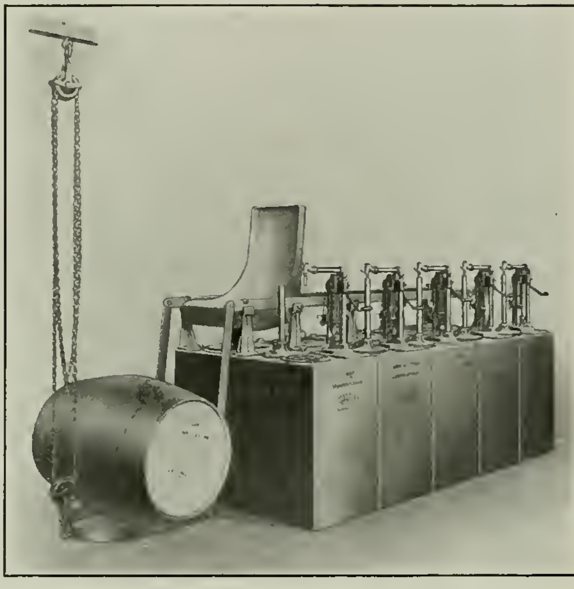
This head which is applicable to practically all makes of screw machines and turret lathes, which have sufficient space to swing heads of these diameters, has been recently designed by the Landis Machine Company, Inc., Waynesboro, Pa., and will be ordinarily furnished with a standard shank. Special shanks may be furnished provided they are not required to be larger than the standard shank.

STORAGE SYSTEMS FOR LUBRICATING OILS

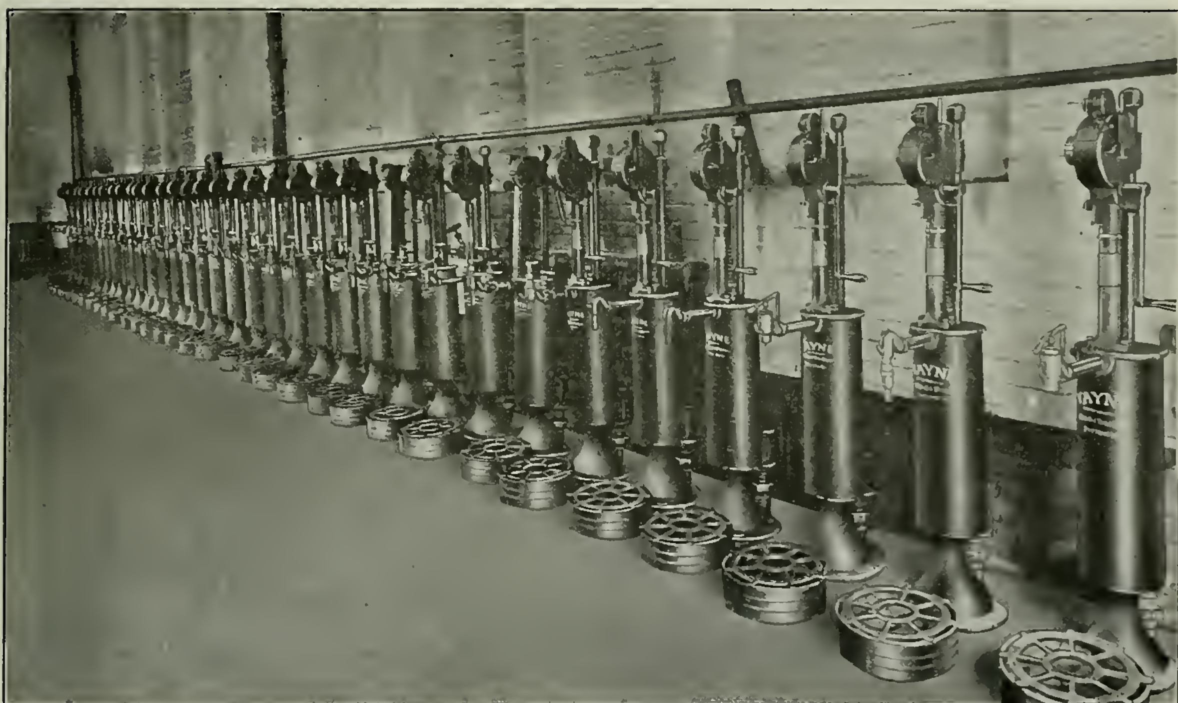
THE battery of oil pumps shown in the photograph is an example of progress which has been made in the orderly arrangement and safe storage of oil.

The battery storage equipment for lubricating oils is illustrative of a system for handling, storing and distributing lubricating oils in a manner which insures the entire draining of the barrels, as well as providing safe storage of the oil in practically fireproof containers free from dust and dirt, with the added advantage of accounting for every gallon used. The tanks are made in capacities of from two barrels up, in batteries formed as shown which can be added to as required, the height and length from the front to the back of the entire battery remaining uniform and the width of each unit across the front varying according to capacity. The equipment may be placed where the liquid is used and the arrangement of the barrel cradle, track and dash affords a means by which the entire contents of either iron drums or wooden barrels may be handled and emptied into storage tanks without waste and with a minimum of labor. Each equipment is fitted with an individual dip gage, providing a check on incoming oil or the contents of the tank. Likewise a measuring pump equipped with pump locks provides a check on all outgoing oil.

The oil storage equipment described is manufactured by the Wayne Oil Tank & Pump Company, Inc., Ft. Wayne, Ind.



Battery Storage Equipment for Lubricating Oils



Battery of No. 32 Model E Pumps in Railroad Oil House

HEAVY DUTY HORIZONTAL MILLING MACHINE

THERE is no clearer index of the growth of the American locomotive than is reflected in the tendencies in the design and construction of special heavy railroad shop tools for machining modern locomotive parts. A conspicuous example of recent improvement along this line is afforded in the new heavy duty horizontal milling machine, designed and built by the Newton Machine Tool Works Company, Inc., Philadelphia, Pa., for the Altoona shops of the Pennsylvania Railroad, upon which the heaviest locomotive driving rods are milled two at a time.

Reference to Fig. 2, a general view of the machine from the rear of the operator's side of the table, conveys at once a general idea of its proportions and strength and reflects credit upon the designer's study of the convenience of its operation in the "easy reach" of all feed and control levers; the driving motor located on the opposite side of the operator and out of his way, and the grouping of lubricating cups for table guides, drive and driving gear, bearings, etc., at the base of the pedestal in plain view of the operator, thus tending to minimize the dangers of damage from "running dry." The strict observance of "safety first" is indicated by the enclosing of all gears.

The base is of the closed top safety type and is one and three quarters times the milling length of the table. Cheeks cast as an integral part of the base for the upright mounting are extended. The uprights are of deep box section carried to the floor line and bolted, keyed and doweled to the base.

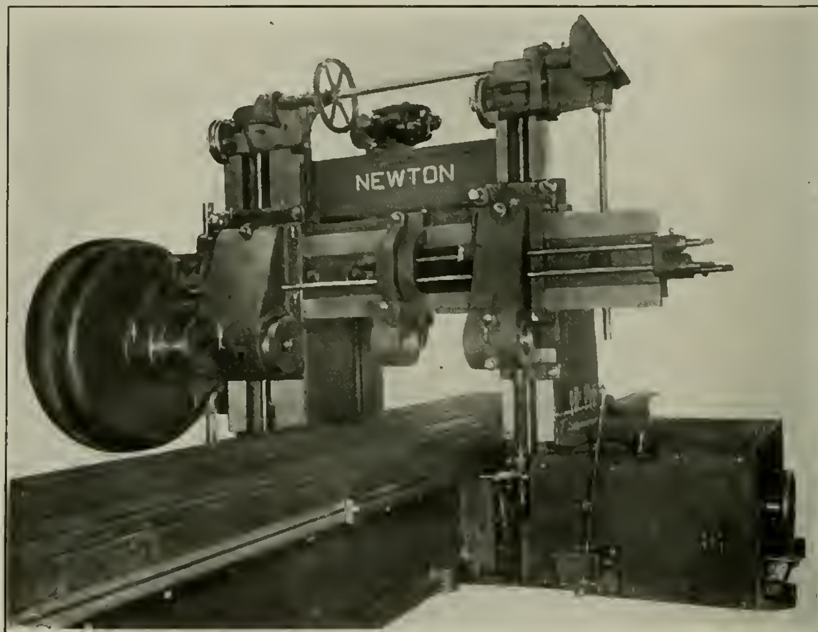


Fig. 1—View from Operator's Position Showing Convenient Location of Control Levers, etc.

Fig. 2—View of Newton Horizontal Milling Machine from the Rear of the Operator's Side of the Table

The machine is driven by a 75-hp., 400-1,200 r. p. m. motor. Fig. 2 shows the convenience of arrangement of control levers from the operator's position as well as the additional lubricator cups on important spindle bearings and crossrail slides.

The table is supported its full length and has five T-slots planed from the solid with drill stop pin holes at each end. It has a 20-ft. travel, and four changes of speed provided by a steel angular rack and phosphor bronze spiral pinion from a box in which there are mounted adjustable sleeves which give the changes without the removal of gears. An adjustable automatic stop is provided and the table is surrounded by a pan to collect overflow oil which is drained to the reservoir at the base. The rapid traverse and feed clutch are interlocked to prevent simultaneous engagement. The working width of the table is 42 in.; the maximum distance from top of the table to the center of the spindle 31 in., and the minimum distance, 4 in. The width between uprights is 51 in.

The crossrail is of the straight faced type and provides 10 in. of side adjustment to the spindle by a screw from the right hand end of the machine. The crossrail is supplied with one outboard bearing, and one intermediate bearing. The intermediate bearing provides for quick removal with the arbor. The crossrail is counterweighted and has a power rapid traverse in both directions through double lifting screws operated by a separate motor. The 5-hp., 1,150- r. p. m. lifting motor is mounted on the tie beam which also serves as a gravity tank, to which the lubricant is pumped from the reservoir in the base. Hand adjustment is made to the crossrail from the end of the rail. There is a boss on the bottom of the crossrail at the right hand side which, in connection with a gage stop on the upright, is used for gaging heights. The counterweight ropes are of such length as to allow the weights to operate in a pit, and the wheels are so arranged that the ropes follow the contour of the uprights.

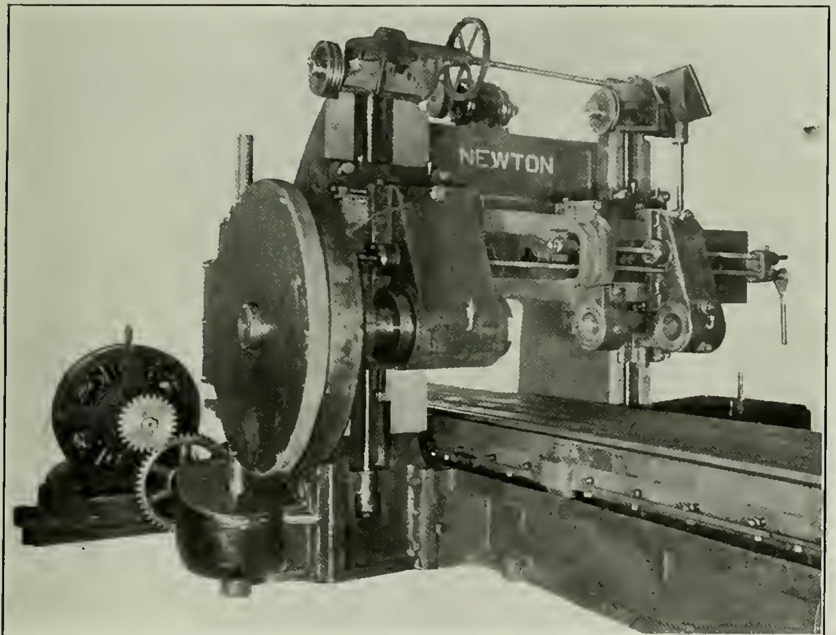


Fig. 3—Showing Application of Motor Drive

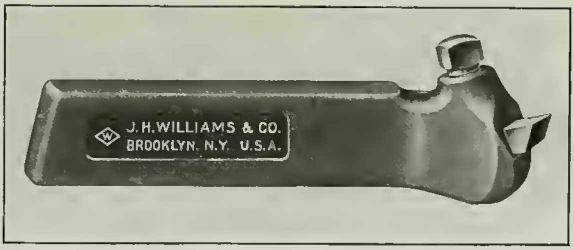
The bearings for the driving worm and driving worm wheel are cast integral with the crossrail, and have sliding sleeves for the spindle. The crossrail is gibbed to the main or wide upright only, with the narrow guide construction to assist in maintaining alinement, and is fitted with a continuous steel taper shoe for taking up wear. The crossrail is carried on two lifting screws, which are held in tension at both ends to prevent buckling.

The spindle is of taper end construction for taking up wear and maintaining alinement, is provided with an internal taper hole, has a through hole for an arbor retaining holt, has a broad faced keyway for the cutter arbor, and is bronze bushed throughout. The spindle diameter through the driving worm is 7 in.; the diameter of the large end is 11 in.; it is driven by a phosphor bronze worm wheel and hardened steel worm having roller end thrust bearings, all of which are encased and run in oil. The driving worm shaft is double splined and the bearings in the worm box are protected by sleeves which are keyed to the driving shaft, rotating with it in bronze bushings, so that the keyways do not come in contact with the bearings.

A view from the right hand or motor drive side in front of the spindle is shown in Fig. 3 and gives convincing evidence of the strength of design and construction of the driving part of the machine.

NEW DESIGN OF SET SCREW TOOL HOLDER

A SET screw pattern toolholder has been added by J. H. Williams & Company, Brooklyn, N. Y., to their line of Agrippa toolholders. It is made with both the right and left hand offset and straight shanks. Where the cutter fastening device is in the shape of a cam the range of contact is limited. The set screw fastening has been provided for use where the steel used in the cutters is not ground to size and varies beyond established limits. The set screws are made of alloy steel, thus insuring strength and toughness. The holders have a bevel on the nose in order that they may be used in close quarters. They are drop forged and are given special heat treatment.



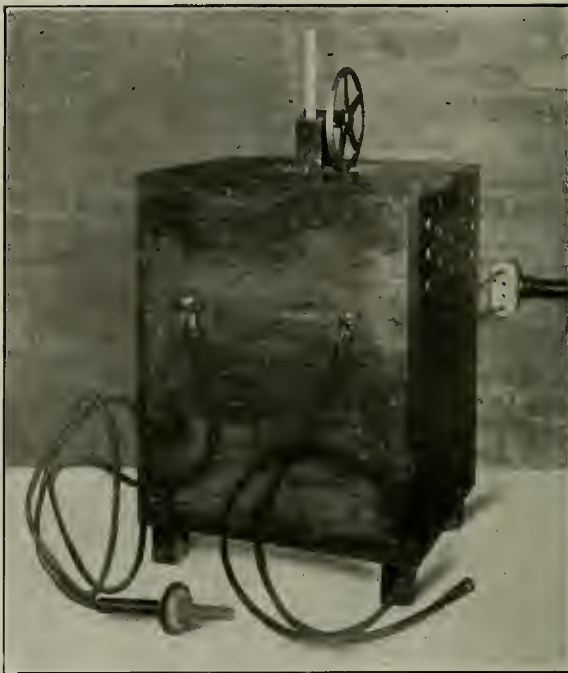
Set Screw Type of Tool Holder

ALTERNATING CURRENT ARC WELDING EQUIPMENT

THE new Zeus arc welder, manufactured by the Gibb Instrument Company, Detroit, Mich., has been designed to overcome the disadvantages of bulk and moving parts which are inherent with all types of motor generator welding apparatus. The new welder consists of a simple transformer with no moving parts. The Zeus welder is comparatively small, making it unnecessary to set aside special space for its accommodation. It is built on the unit system, which makes it possible to connect a duplicate machine in parallel with the original when the work becomes too heavy for a single machine to handle.

One of the outstanding features of the welder is its arrangement for regulation. It is not necessary to change any connection for the purpose of regulating the arc. A hand-wheel is conveniently located on the top of the machine and furnishes a means whereby the secondary winding may be raised and lowered to provide for the regulation necessary for various conditions of work and sizes of electrodes. It is claimed by the manufacturer that the inherent reaction of the transformer automatically stabilizes the arc for different arc lengths and that the current consumption is from 20 to 40 per cent less than that for motor generator welding equipment. It is also claimed that, due to its inherent characteristics, the machine is particularly adaptable to overhead welding.

The particular advantages offered by a welding outfit of this kind lie in the fact that it is portable and that it may be operated from almost any alternating current circuit used for power or lighting. Because of these characteristics, it is frequently possible to use the welder in many places without having special circuits for the purpose.



The Handwheel and Connections Are the Only Exposed Parts

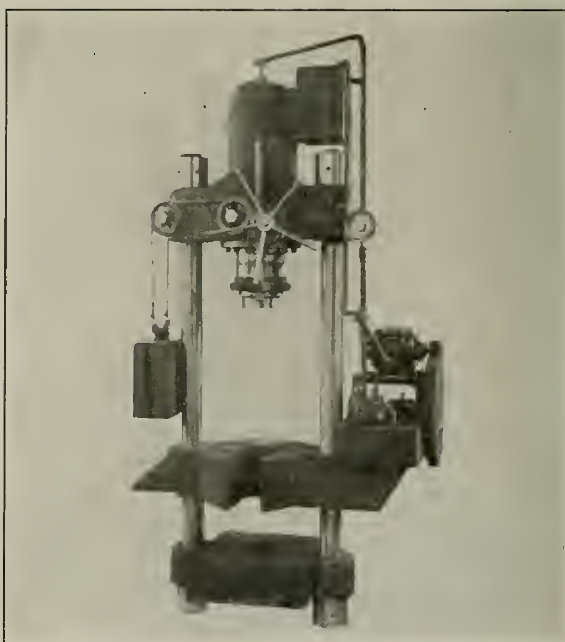
SPECIAL HYDRAULIC PRESS FOR RAILWAY SHOP USE

AN improved type of 200-ton hydraulic forcing press has recently been furnished the Pennsylvania Railroad by the Hydraulic Press Manufacturing Company, Mt. Gilead, Ohio. It is especially designed for the purpose of quickly pressing driving brasses in and out of boxes and piston rods into pistons, and occupies very little floor space.

The bottom base—72 in. from the face of the raised ram—and the cylinder are of cast steel securely mounted on the substantial perpendicular steel uprights or strain rods; they are secured by steel spanner nuts held in place by set screws bearing on copper slugs. The lower base is provided with an 8-in. hole and is designed to stand the effect of full force of the press. The intermediate base, which is 45 in. from the face of the ram, is held in position by screwed collars through the lugs cast on the base and bearing down against the collars on the strain rods. The intermediate base is also of cast steel and is provided with a U-shaped opening 8 in. wide, through which the driving brasses are intended to fall as they are pressed from the boxes.

The press is furnished complete with pump attached, ready to operate by motor drive as shown, or it may be provided with a belt drive. It is equipped with automatic knock-out valves for maximum pressure, also with spring relief valves. The discharge from the main press cylinder, as the ram is raised, is forced into the surge tank at the top, and any surplus liquid which flows into the surge tank overflows to the pump reservoir.

A part of the stroke of the ram is made without any pressure registering on the gage; this is taken care of by a

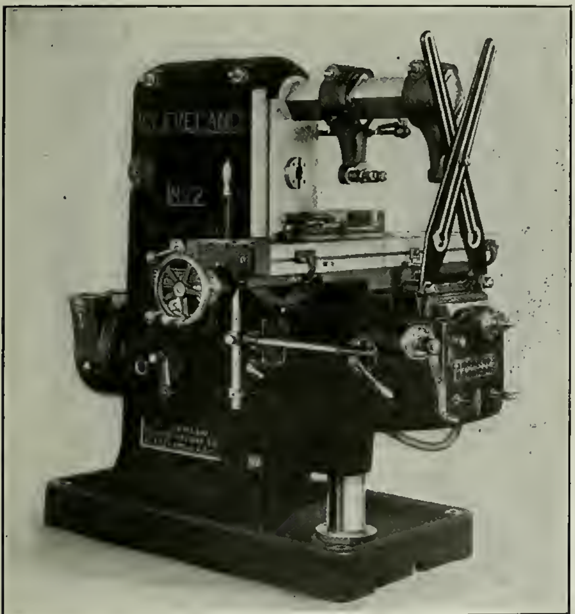


200-Ton Inverted Forcing Press With Two Bases rack and pinion, so that the ram can be brought down to the work by hand. When this is done the cylinder is filled with water from the surge tank which is bolted to it; the water enters the cylinder from the tank through a check valve. When the ram stops the pump delivers the water to the main press cylinder through another connection and the check valve closes. The ram is counterweighted and will stay in any position where it may be placed.

MILLING MACHINE WITH SPECIAL ATTACHMENT

The design of the milling machine shown in the illustration is noteworthy in respect to several features, most conspicuous of which is the square overarm and the handy and easily attachable vertical spindle milling attachment, a combination provided to meet the demand of those who, having a certain amount of vertical or face milling work, are unable to keep a vertical milling machine continuously busy. This machine, of the plain and universal types, as well as the vertical milling attachment, are the products of the Cleveland Milling Machine Company, Cleveland, Ohio. The machine is made in two sizes and the following details of construction apply to both models.

The column is of rigid construction—a complete box section—and is cast in one piece with the base, a heavy, ribbed, semi-steel casting, with heavy vertical and horizontal walls, the only openings in which are those necessary for the change gear levers on the front, the pulley drive housing in the rear, and the cutter lubricant tank on the left side of the machine. All of the interior parts are lubricated automatically, and all adjustments on the bearings are made from the outside. The dove-tail knee slide extends upwards to the overarm, affording ample surface for clamping the attachments. The depth of the column has been carefully determined in order to place the spindle and the shaft bearings in proper relation to each other to secure maximum rigidity. The horizontal wall separating the lubricating oil reservoir from that of the cutter cooling compound is designed to give added rigidity to the column; the lower surface of the base is finished so as to give it a firm foundation, while the contour of the upper surface of the base is pan-shaped with depth enough to catch oil and chips, thus keeping the surroundings clean.



Cleveland Plain Milling Machine

The knee is designed with an improved dove-tail slide and the bearing of the saddle is on the flat, wide surface, the narrow slide acting as a guide only. The bearing of the knee on the column is carried well above the top of the saddle slide, thus giving the knee a longer bearing on the column, reducing the bearing pressure to a minimum. The feed box, as well as the knee, is entirely enclosed. The elevating screw is large in diameter and in one piece. By the use of the post the telescopic screw has been eliminated, as it acts as a support to the elevating nut and as a guide in the knee. The screw is operated with a double bevel gear, the hand feed and power feed being independent of each other.

The table is machined all over to insure proper alinement and the bearings on the table are at the top of the saddle instead of at the bottom of the dove-tail, which method secures a large bearing surface and locates the bearings, which are automatically lubricated by rollers, a greater distance apart. The bearing on the saddle is also at its widest portion, and both saddle and table bearings are taken up with long taper gibs which are provided with adjusting screws at both ends.

The square overarm provides positive alinement of the arbors and maximum rigidity of the arm pendants. It is impossible for the operator to place the arbor supports on the overarm and on the arbor in any other way than exactly in line. Owing to the firmness which the square overarm imparts to the machine a great variety of work can be performed.

The flanged spindle eliminates the overhang on the end of the spindle as well as the trouble caused by cutters screwing fast into it, and also allows the cutter to be run in either direction. On the flanged spindle is a face keyway, inserted into which are hardened steel jaws for driving arbors and face mills. It is unnecessary to remove these at any time to change from a face mill to an arbor, as the driving is done by the hardened steel jaws. The strain is therefore taken off the taper hole. The spindle is provided with a positive lock that enables the operator to loosen the arbor nuts with the least possible difficulty and is also provided with a handwheel to revolve the spindle, which feature the operator will find convenient on boring jobs and other milling operations. The spindle lock cannot be operated while the machine is running, nor can the main driving clutch be thrown in while the spindle is locked.

All the bearings in the column and knee are thoroughly covered with lubricant while the machine is running, thus relieving the operator of the responsibility of oiling the most important parts of the machine and eliminating the necessity of oil holes in any of these parts. The oil reservoir requires refilling but twice during the year. As high speed steel cutters are used almost entirely there has been provided a reservoir of ample size for cutter cooling lubricant, which is circulated by a centrifugal pump operating only when the spindle is in motion.

The speed and feed arrangements are both of the sliding gear type. Changes of speeds as well as feeds are made by two levers conveniently located for the operator. The spindle speeds are 16 in number, in either direction, and the feeds are 16 in number in either direction also, so that this machine will handle all classes of cutters. Speeds and feeds being in geometrical ratio, the correct changes of speed and feed for the work to be done can be made without trouble. All gears and shafts in the drive, as well as the feed, are of hardened steel, automatically lubricated, running in bronze bearings, and protected against breakage by a safety device.

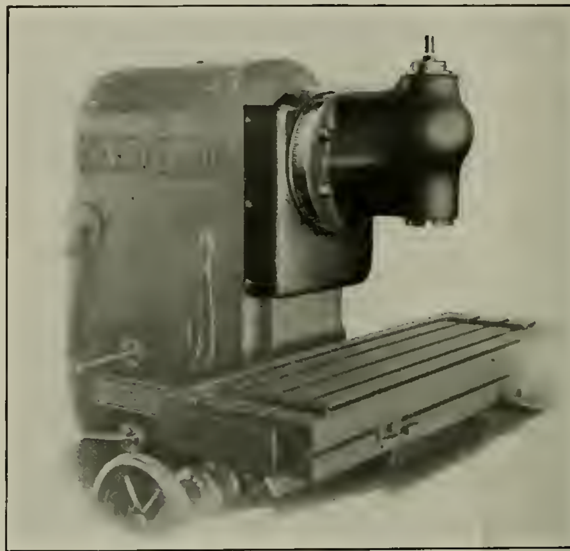
The power is transmitted through a constant speed drive pulley and the machine is so designed that it requires no loose gears on the spindle. All shifting of gears is done on the secondary shafts below the spindle. The starting and stopping lever may be operated from both sides.

The principal dimensions of the smaller machine which occupies a floor space of 70 in. by 60 in., include a table whose working surface provides an area of 44 in. by 12 in. and has three ⅝-in. T-slots and a right and left adjustability of 50 deg. In the larger model, occupying a floor space of 92 in. by 98 in., the table swivel right or left is the same as that of the smaller machine, while the working surface is 50 in. by 13 in.

The smaller size has a longitudinal range of 22 in., a cross range of 8 in. and a vertical range of 15 in., while the larger type has 28 in., 10 in. and 15 in. ranges, respectively. The overarm is 3¼ in. square on the small size and 3¾ in. on the large; the motors recommended are 5 hp. and 7 hp., respectively.

The vertical spindle milling attachment referred to is shown in one of the photographs. It is bolted to the column and ready for action and is manufactured in three sizes, the distances from the face of the column to the center of the vertical spindle being 10¾ in., 12½ in. and 15 in., respectively. The minimum distances from the nose of the spindle to the table are 1¼ in., 1½ in., and 2 in., and the maximum 16½ in., 16½ in. and 18 in., respectively. The spindle taper holes are No. 10, 11 and 12 Brown & Sharpe and the shipping weights range from 225 lb. to 415 lb.

The drive is taken from a gear fastened to the nose of the spindle, which drives a spur gear on the horizontal shaft and the spindle is in turn driven by a large mitre gear. All gears and shafts are made of steel and enclosed, running in bronze bearings throughout. The bearings on the spindle are the same as the milling machine spindle and form two



Vertical Spindle Milling Attachment

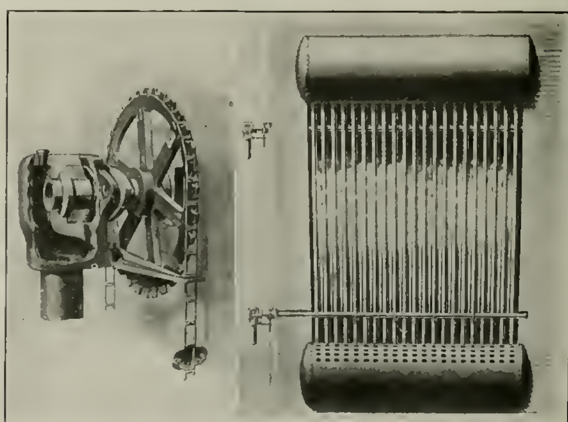
taper cones in opposite directions, adjusted by a nut on the outside of the spindle. The base of the head is graduated so that it may be set at any angle in a vertical plane parallel with the elevating screw, and the attachment when clamped in position on the dove-tail slide of the column which extends above the center line of the spindle, is as rigid as if it were a part of the milling machine.

AN AIR TIGHT SOOT CLEANER SWIVEL HEAD

An improved soot cleaner swivel head which provides for easy and convenient operation, and does not leak steam or permit air infiltration is shown in one of the illustrations with a part of the swivel head cut away to show the relation between the steam delivered to the swivel head from the vertical riser or pipe, and its entrance into the movable horizontal element or spray pipe. The latter is fitted with steam turbine nozzles through which steam at high velocity is sprayed upon the boiler tubes, thus blowing off soot deposits as the spray pipe is revolved by means of the chain operated sprocket to which it is keyed.

A detail which merits attention is the method of packing the stuffing box in the swivel head. It will be seen that the spray pipe has a collar near its end which fits against metal on one side and the packing on the other. It is designed in such a way that when steam is turned on friction is relieved and turning the element by hand becomes easy. As the vertical riser expands or contracts the swivel head rises or falls, carrying with it the end of the spray pipe. Air infiltration, as the result of this movement, is prevented by the use of an air tight sliding joint between the sprocket wheel and the metal housing, which is mortared into the brickwork.

A typical installation of the Vulcan soot cleaner, which is manufactured by the Vulcan Soot Cleaner Company, Du Bois, Pa., equipped with the new Vulcan swivel heads is also shown and it will be noted that the installation is well anchored in the brick walls, the spray pipe being supported on the tubes at four intermediate points. Convenient stops on the sprocket chain limit the amount of rotation and a pointer on the sprocket wheel indicates direction of sprays.



(Left) Sectional View of Swivel Head of Soot Cleaner. (Right) Application to Stirling Boiler

FOUR-SPINDLE AUTOMATIC SCREW MACHINE

THE improvements in the new automatic turret lathe illustrated herewith, are intended to overcome some of the inaccuracies which often result from mismanagement by relatively incompetent operators. The machines are built in three sizes, the smallest type accommodating stock up to and including ½ in. in diameter, the medium type taking up to and including 1 in. in diameter and the largest size capable of machining metal up to and including 1¼ in. in diameter; an additional model is in prospect for work up to and including 1½ in. in diameter.

An outstanding characteristic of the new lathe lies in its compactness and rigidity of design. A stripped bed is shown in Fig. 2 for convenience in illustrating this feature of rigidity and it will be noted that the bed is a solid casting from the bottom of the feet to the top of the tool knee, thus avoiding bolting on of brackets and bosses.

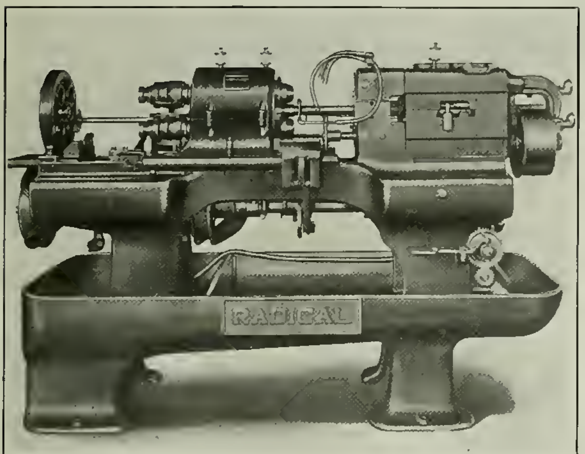


Fig. 1. Radical 4-Spindle Automatic Turret Lathe

The cylinder and cylinder housing are of semi-steel. The length, diameter and weight of the former compared to the length of the cylinder bearing and of the carriage ways, prevent jumping, tilting or lifting of the cylinder or the carriage. The cylinder carriage movements are to and from the tools to the roll which is held on the bottom of the carriage by a pin. This roll engages the groove on the face of the lead cam, the hub of which is keyed to the cam shaft, which is driven through the cam shaft gear box located on the end of the bed within the pan. Through this gear box the cam shaft is revolved at different speeds to give a fast or slow travel to the carriage as may be required.

The spindles are one-piece steel forgings, heat treated and ground. They run continuously in one direction and are gear driven. Four changes of speed are provided and by removing a split collar and placing it on the opposite side of the driving gear four more changes of spindle speeds may be obtained. The machine provides 10 changes of cam shaft speeds and the eight changes of spindle speeds without pulley change.

Adjustments have been simplified and all adjustable strips on drives eliminated by the use of the so-called "stay-put" cams, one of which is illustrated in Fig. 3.

Ingenuity has been shown in the development of the different mechanisms for controlling the indexing. On the rear of the cylinder is a separate jigged gear which meshes with a pinion gear on the indexing shaft. This pinion gear is keyed to the index shaft and moves forward and backward with the shaft and cylinder carriage travel. As the cylinder carriage reaches its receded position the pinion gear, also keyed to the shaft, meshes with a segment which moves upward by a lever and cam movement. This upward movement is of sufficient duration to give the cylinder a quarter revolution, bringing each one of the spindles in line with the next tool. The connecting rods between the cam and the segment have lock nut adjustment to take care of the wear. The entire mechanism is located at the side of the machine at about the height of the carriage ways. The index shaft carrying the pinion gear extends back to the stock reel frame and on that end carries a pinion gear which meshes with an indexing gear in the reel. In this way the reel is indexed with exactly the same motion as the cylinder, the advantage of which feature lies in doing away with the strain from indexing the reel with bars of stock projecting from the spindles.

The mechanism for locking the cylinder after it has been indexed, is interesting. A hardened and ground bushing fits into a ground hole in the cylinder. A hardened and ground plunger operates through a hardened and ground bushing in its boss, being withdrawn by hand by a lever and automatically by a locking pin cam. The plunger is seated by a spring and is held in position by the cam. The end of the plunger is externally tapered to fit a corresponding taper in the bushing. Provision against wear is made by two additional inside tapers, one in the plunger and one in the bushing; these two sets of tapers check each other at all times. Should either set of tapers become worn, the other set will complete the locking until such a time as the worn set reseats itself. A double throw cam prevents the possibility of any rebound of the plunger from the bushing in the cylinder.

The chuck operating slide and the stock feeding slide are designed to permit of free and positive action for the entire chucking and feeding mechanisms without the use of levers and arms, by using slides which are carefully scraped and operate in scraped bearings, the operating, hardened and ground rolls being assembled directly on the bottoms of the slides so as to come into direct contact with their cams.

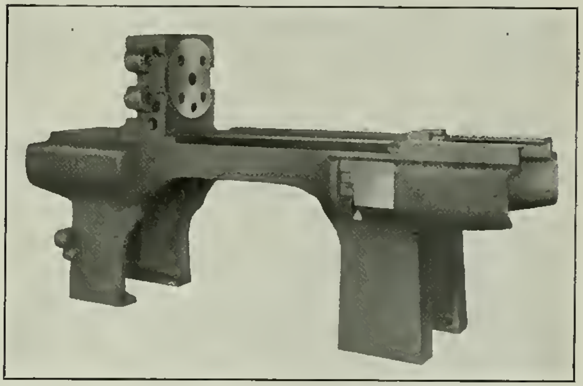


Fig. 2. The Stripped Bed Gives Some Idea of the Rigidity of the Machine

The throw from fast to slow cam shaft speeds is effected by shifting the trip dogs on the worm wheel, these dogs operating to throw the lever, which in turn operates the Johnson clutch within the gear box. The securing of different cam shaft speeds for cutting is accomplished by pushing the shifter handle in or out, operating on a graduated rod, which throws into mesh different trains of gears within the gear box. This rod is graduated for eight changes of speed, four being obtained with the gears in one position and four additional by substituting other gears.

The gage stop is capable of simple adjustment and of being easily pushed out of the way for the operator's convenience. A rod, 1½ in. diameter, projects from the lower front of the tool knee between the fourth and first positions and has crosswise slots ⅜ in. apart, into which drops a lip from the tool knee. This lip holds the shank securely in any selected position; on the end of the rod is a cap for finer adjustment.

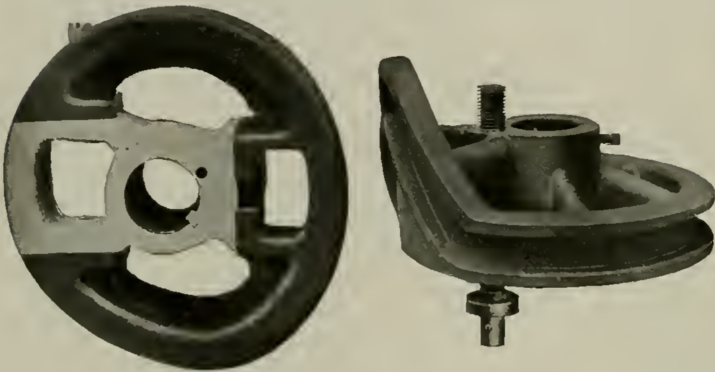


Fig. 3. Two of the "Stay-Put" Cams

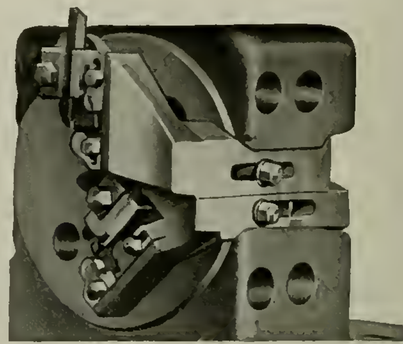


Fig. 4. Turner Slide for Holding Tools

The threading device proper is installed in two boxes, one in the third position and one in the fourth position, which boxes are interchangeable. Changing from one threading position to another does not require stripping the machine, but rather the simple loosening of a screw which holds the box in place on its dove-tail slide.

The lubricating oil is drawn by a chain driven, geared pump and forced into a reservoir within the tool head, where it is held under pressure for distribution to the cutting tools.

The familiar tool known as the box mill has been superseded by what is known as a Turner slide type of tool, which is illustrated in Fig. 4; a micrometer adjustment is used for raising and lowering the cutting blades.

This machine is the product of the P. W. V. Automatic Machine Corporation, Fitchburg, Mass.

PORTABLE TRANSFORMER FOR LEAD BURNING

THE most modern method of burning terminals in place on storage batteries, removing old connections, cutting off or building up posts, or in fact almost any form of lead work, is to do it by the electric welding process. The General Electric Company, Schenectady, N. Y., has recently developed a lead burning transformer especially designed to meet this need.

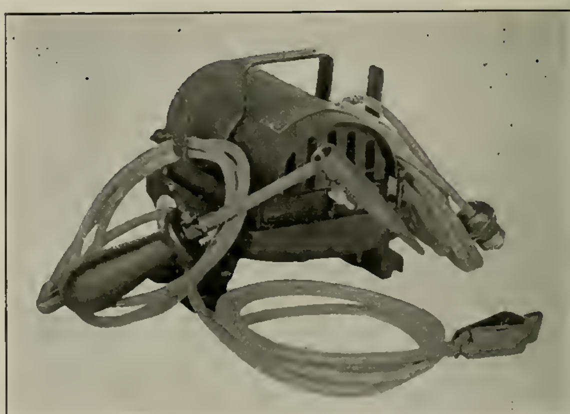
This transformer is designed to be connected to the ordinary 110-volt alternating current lamp socket, a 10-foot cord with a plug being provided for this purpose. This attaching cord is protected by a special rubber covering against the hard wear, dirt or acid with which it may come in contact. Connection to the transformer itself is made by means of a plug and socket connection so that this plug can be used in place of the snap-switch in the lamp socket for turning the current on and off.

Two separate rubber covered terminal leads are used to convey the low voltage heat producing current to the parts of the battery to be welded. The lead having the "Big Brute" clip is for fastening to the battery plate or posts which are to be worked on. The other lead has at its end a carbon holder which is arranged with a heavily insulated handle so that the operator's hand is guarded from the heat. The carbon holder takes any ordinary arc welding carbon, this carbon forming the second terminal.

When the pointed arc welding carbon is brought into contact with the lead the pointed end of the carbon becomes intensely hot, so hot that it melts the lead over a restricted area quicker than a pointed gas flame will do it. The welding or burning operation is carried out by a sort of puddling process, the carbon terminal being manipulated to flow the lead where it is needed.

It will be noted that this is not an arc welding process, and that no arc is drawn during the burning, but the nose of the carbon is kept immersed, perhaps 1/16 in. in the lead.

Among the advantages of the electric lead burner is that repair work in hard-to-get-at corners can be done more easily



Transformer Equipped with Attachment Plug, Big-Brute Clip and Welding Tip

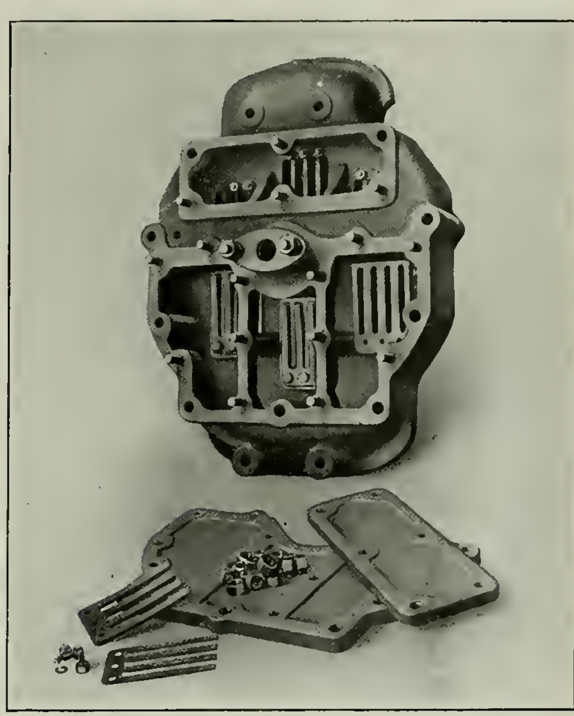
as the heat is always right at the point of the carbon, the device is readily portable weighing approximately 25 lb., joints do not have to be cleaned as the dirt and slag automatically rise to the surface of the molten lead and the surfaces are joined while cleansed; when properly used, there is no glare to injure the operator's eyes, as he looks down on the cool end of the carbon in such a way that the bright point where the carbon touches the lead is hidden from view; there is no danger from electric shock because of efficient insulation.

On the basis of 10 cents per kilowatt hour, it costs about 8 cents per hour for current when the device is operating steadily. The instant the carbon point is removed from the work, the current consumption practically ceases, as the device then takes only 4½ watts from the line.

Owners of these transformers have found an increasing field of application. The device is said to be especially valuable in reconstructing and repairing batteries; while in the shop and foundry it has been used where all kinds of odd soldering jobs must be done. The device has also been found applicable in plumbing, roofing, tank building, etc.

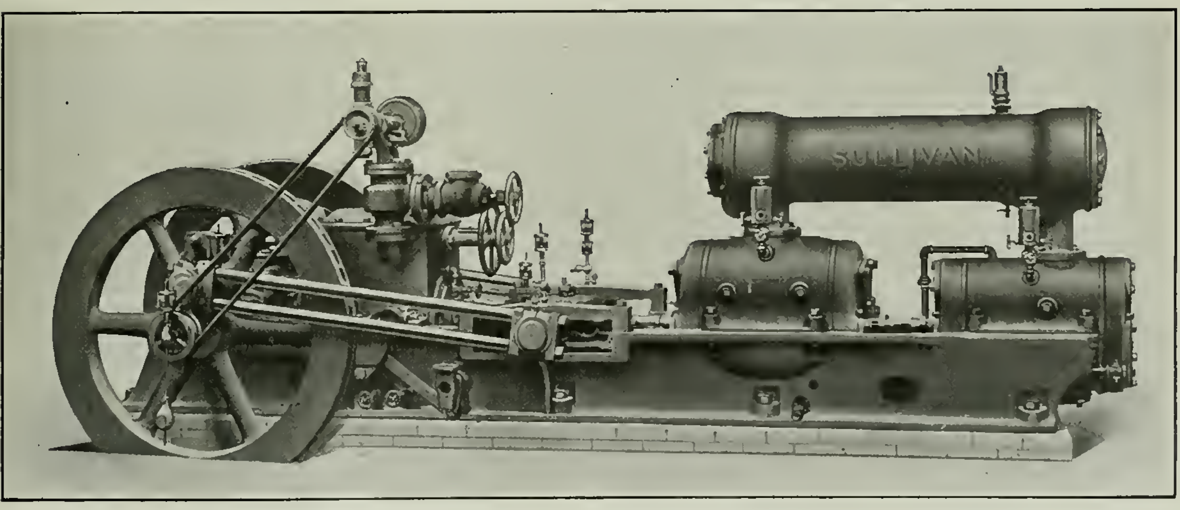
AIR COMPRESSOR WITH PLATE TYPE VALVES

THE air compressor shown in the photograph is a redesign of an earlier straight line type of two-stage compressor with a single steam cylinder and two air cylinders, and provides from 400 to 940 cu. in. of free air per minute, compressed to a maximum pressure of 100 lb. per sq. in. One of its principal improvements consists of a speed and pressure governor admitting of three adjustments, namely, maximum and minimum speed and air pressure, each adjustment being independent of the others. The speed controlling element is entirely enclosed in a casing to protect it from dirt.


Cylinder Head with Valve Covers and Some of the Valves Removed

End rolling finger valves constitute another important new application to the air cylinder heads and are illustrated in the view which shows a cylinder head with the cover removed. These valves consist of thin flat steel sheets cut to form four finger-like blades; these are bolted at one end to the cylinder heads so that the fingers seat over long narrow ports which are opened or closed according to whether the fingers rest flat against the seat or are bent backward away from it. To protect the valves and prevent excessive lifting from the seats they are covered by steel guards having the same general shape as the valves, but made of a thicker material and given a definite curve away from the valve seat. In opening the fingers impinge against these guards with a rolling motion, hence the name "rolling finger valve." It is stated that the end rolling effect eliminates the hammering which commonly occurs in the operation of air valves and provides a rapidity of action, wide port opening with minimum wire drawing, and a reduction in the number of moving parts.

These pumps, known as the Sullivan WB-3 air compressors, are manufactured by the Sullivan Machinery Company, Chicago, in two sizes.



Class WB-3 Air Compressor, Straight Line Type with Simple Steam and Two-Stage Air Cylinders

A MACHINE FOR SHARPENING OLD FILES

THE American file sharpening machine, manufactured by the Abrasive Machine Company, Irvington, N. J., is designed for the resharpening of old files of all kinds. The resharpening of a dull file is accomplished through the grinding action of a patented abrasive combination known as Carboflynt, mixed with water, propelled at high velocity by a jet of steam through a nozzle.

A cross section of the nozzle (Fig. 1) shows a flat file in the proper resharpening position, resting on the bevelled edge of a block of metal called the "test iron" because of the fact that a properly resharpened file will gently adhere to its surface. The correct angle of the file to the jet of Carboflynt shown projected from the nozzle is about 30 deg. and the bevel on the test iron serves as a guide to the operator in handling the file.

An enlarged longitudinal section of the teeth of a new file is shown at *A* in Fig. 2; the result of the grinding action on the teeth of an old file is shown by the dotted lines in *B*, Fig. 2. It will be seen that the Carboflynt jet grinds away the back of the teeth, leaving the cutting edge clean and sharp. The operation requires about half a minute and the resharpening can be performed as often as there are any teeth left to work on.

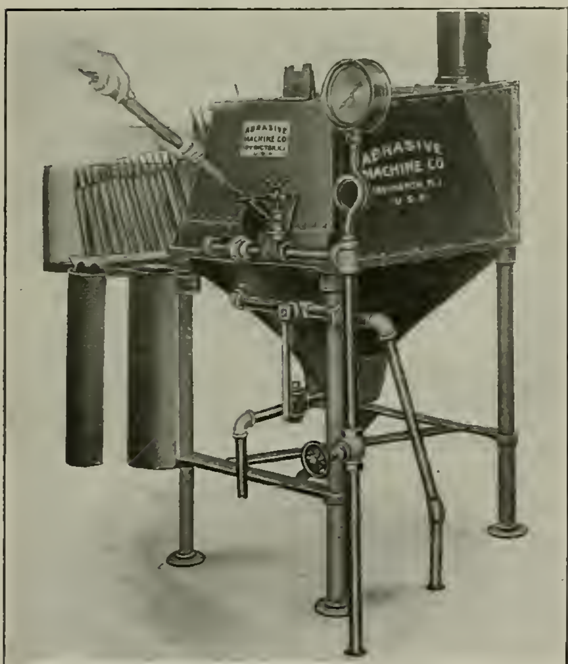


Fig. 3—Machine for Sharpening Files

It is estimated that by the use of this machine, old files can be put back into use, practically as good as new, at a cost not to exceed 10 per cent of their original value. It is further stated that ten pounds of Carboflynt at 10 cents per pound will resharpen $300 worth of files, owing to the fact that the Carboflynt is used over and over again.

The complete machine is shown in Fig. 3 and consists of a sheet metal box mounted on a stand with an opening in front for admission of the nozzle and the file. The partly open window on the left is for the purpose of replenishing the supply of Carboflynt and water when necessary; an overflow pipe controls the level of the water in the hopper.

The vertically mounted cylindrical tank at the right hand side is a water container, used for dipping files to clean them when drawn from the chamber.

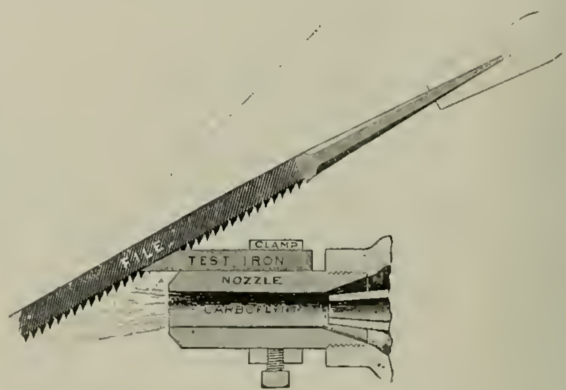


Fig. 1—Cross-section Through Nozzle Showing Flat File in Position for Resharpening

The method used in the treatment of files in the American file sharpening machine does not subject them to the danger of "losing their temper" in the slightest degree, and this fact is gradually overcoming the prejudice which has existed toward "file sharpeners."

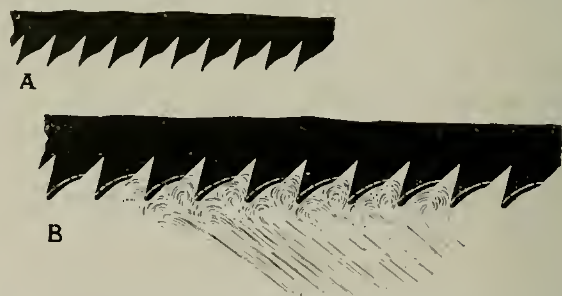


Fig. 2—(a) Shape of Teeth on New File. (b) Dotted Lines Show Recut Teeth

A typical installation is shown in Fig. 4. Steam is piped directly from the boiler to the nozzle through a ¾ in. pipe;

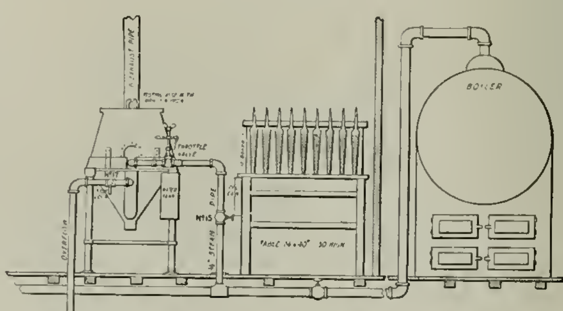


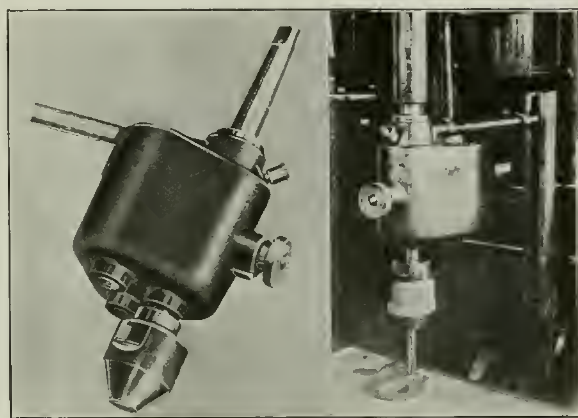
Fig. 4—Typical Arrangement of Apparatus Used for Sharpening Files

the pressure recommended for the best results is from 85 to 150 lb. of steam. Where steam is unavailable, compressed air has been used with success. Among recent installations that have been made are machines for Pennsylvania Railroad at Reading, Pa., and the Mobile & Ohio Railroad at Murphysboro, Ill.

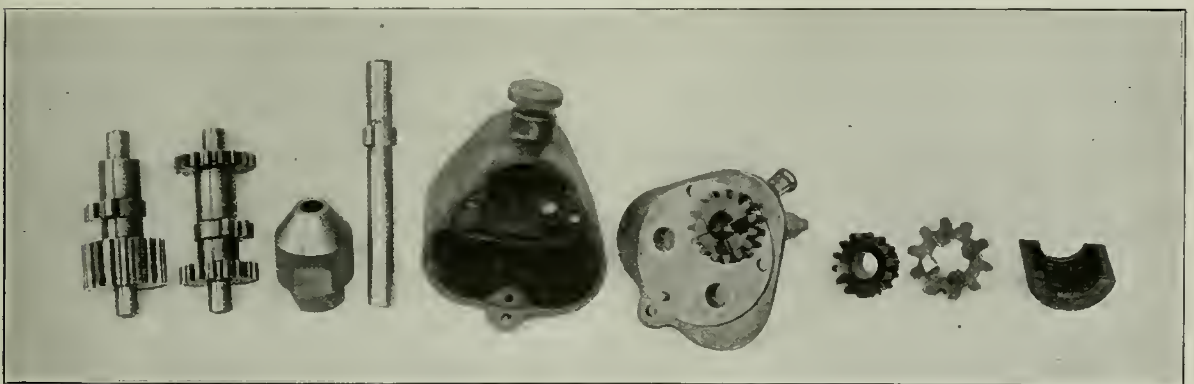
BACKING OFF THE TAP MECHANICALLY

THE mechanical tapping attachment for a drill press shown in the photographs is so constructed that in operation it imitates the motion of the human hand, advancing the tap into the work and then, reversing itself automatically, it backs out the tap sufficiently to clear itself, when it again resumes its forward direction. This is particularly necessary in tapping steel or tough material. The forward movement being greater than the backward movement advances the tap. The return movement in backing the tap out is continuous and at an increased speed. This automatic oscillating operation is considerably faster than hand tapping. By the use of this apparatus the entire tapping job may be done with the finishing tap only, thus eliminating the preliminary work of starting taps; the time saving economy of this, in addition to the speed at which the apparatus can be run, is manifest.

The device is foolproof and strongly made; no springs are used in its design and it can be instantly changed from the oscillating to a continuous drive for use in soft metals where the automatic "backing off" is not required, by the operation of the knob on the front of the machine. Turning the knob disengages a clutch, which throws a gear on the countershaft out of mesh with the tapping spindle.



(Left) Automatic Tapping Attachment Which Imitates Hand Tapping. (Right) Application of Tapping Attachment



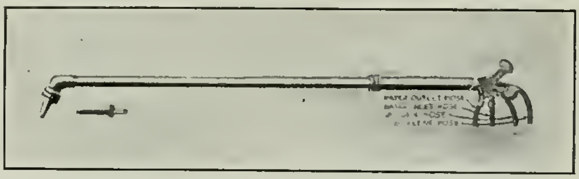
Parts of the Automatic Oscillating Tapping Attachment

These machines, carrying a No. 2 Morse taper shank, are furnished for all sizes of taps up to ⅝ in. by the Wahlstrom Tool Company of Brooklyn, N. Y.

WATER-COOLED WELDING TORCH FOR HEAVY WORK

MUCH time and gas are often wasted because of the overheating of the tip of the oxy-acetylene welding torch when the work must be done in hot corners, in holes, or in the handling of heavy and difficult work. A big saving could also be effected on some jobs if the preheating blast could be kept on the weld while the metal is being fused, or if two or more torches could be used continuously to secure and retain the proper heat. The Admiral Welding Machine Company, Kansas City, Mo., has developed a water cooled torch to meet these difficulties.

The circulation of the water keeps all parts of the torch cool and because of this the torch will work uniformly on a weld of any thickness. It is said that if the torch is suspended from the ceiling by a wire or cable and the welder



Admiral Water Cooled Torch

is protected from the heat, the torch may be kept on a weld indefinitely, and if necessary the welders can take turns in operating it. The torch may be connected to the city water pressure or even to a barrel or tank, as the amount of water required is not very great.

The torch is 34 in. in length, weighs 3 lb., and is furnished with two interchangeable tips. The connections are ground joints and the torch may be quickly taken apart in order to remove any scale or obstruction in the water line. It is finished in brass with knurled fittings.

NEW LUBRICANTS AND CUTTING OILS

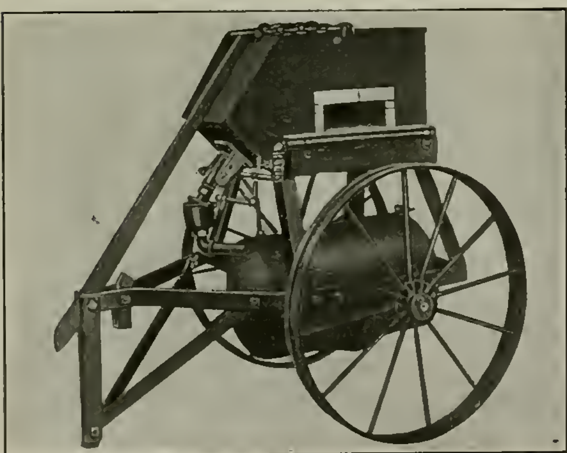
In addition to three grades of cutting oils recommended as substitutes for lard oil on account of their greater cooling qualities, a lubricant especially developed for use in portable pneumatic tools and said to have unusual consistency and lasting qualities, has been recently introduced by the Fiske Brothers Refining Company, New York.

Their No. 1040 cutting oil is light in body and is intended for light cutting operations, No. 1770 is prescribed for medium work and No. 2020 is furnished for extremely heavy work.

A product known as Ferrol Economizer, which is said to be impervious to fresh or salty water or water containing acids, and is not affected by heat or cold, is also manufactured by this company for lubricating gears, chains and ropes, or for use wherever a question of extreme temperature or high bearing pressure with low speed arises.

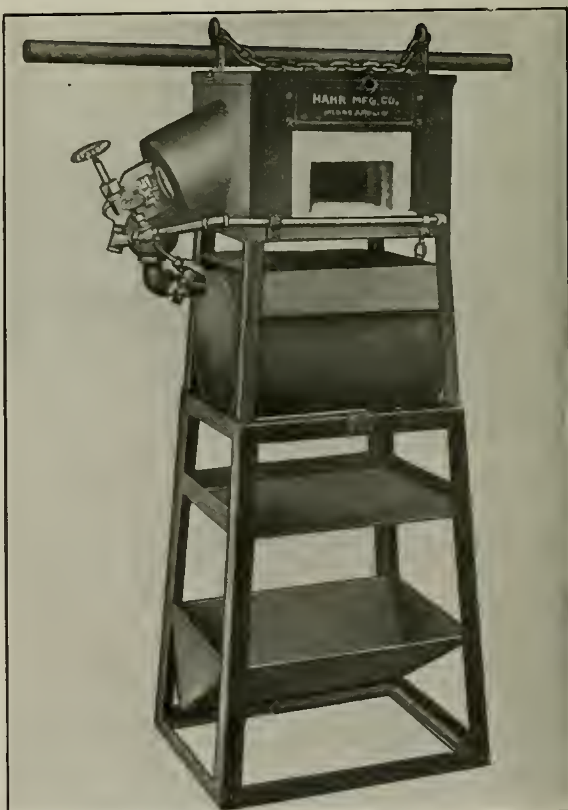
OIL FUEL RIVET FORGE FOR THE REPAIR TRACK

High wheels clear the tracks and the comparatively low center of gravity due to the fuel tank's location near the center of the axle of the wheels in the rivet forge illustrated herewith, decreases the difficulty of getting it from one section of the "rip track" to another in car repair work. The handle used in pulling it folds back against the body of the forge without interference. The operation of this forge, which will heat four hundred ¾-in. by 3-in. rivets per hour, involves the use of a special burner constructed on the vacuum principle, which makes it possible to burn any grade of fuel oil or kerosene, without pressure on the 18-gallon fuel tank. This is a "safety first" consideration of no mean value.



Oil Fuel Rivet Forge for Car Repair Work

The forge is made by the Mahr Manufacturing Company, Minneapolis, Minn., and the burner is of the standard type made by that company. A hollow chamber through which passes the air used in atomizing the oil, extends across the front of the furnace above the opening. At the entrance to this chamber a portion of the air is led down to a point below the furnace, opening into a perforated pipe. From this chamber the air passes to the atomizing valve. An oil chamber is formed in the lower end of the lead, the oil passing up through this chamber, where it is pre-heated. From there it passes to the atomizing valve, being at such a temperature that when the hot air strikes it it becomes immediately gasified, passing into the combustion chamber in that condition. A by-pass from the air pipe passes up above the combustion chamber and feeds air into the furnace, in this way insuring perfect combustion of the oil. An interesting feature in the performance of this furnace is the lack of scale formed on the work; this is accomplished by having



Rivet Forge Mounted on Convenient Stand

a neutral flame, no more air being admitted than is necessary thoroughly to consume the oil. The flow of the air through the by-pass is controlled by a valve, as is the air and oil mixture. The atomizing valve also is of a distinctive design. It is constructed on the piston valve principle and permits passing the impurities in the oil through to the combustion chamber without danger of clogging the valve.

A small portable forge is also shown, using the same principles of operation as the outfit described above. It is conveniently mounted on a strong, wrought iron stand provided with two trays; the bottom one may be used as a cold rivet bin, the upper one for tools.

MULTIPLE PUNCH FOR CAR UNDERFRAMES

BY GEORGE P. THOMAS

President, Thomas Spacing Machine Company, Pittsburgh, Pa.

The necessity of reducing manufacturing cost, with labor cost tending to stay fixed, makes standardization of design a most important consideration in plants engaged in steel construction, such as steel car shops. Only on the basis of standardized design is it possible to take advantage of the possibilities offered by special tools which will increase output and cheapen unit costs through quantity production.

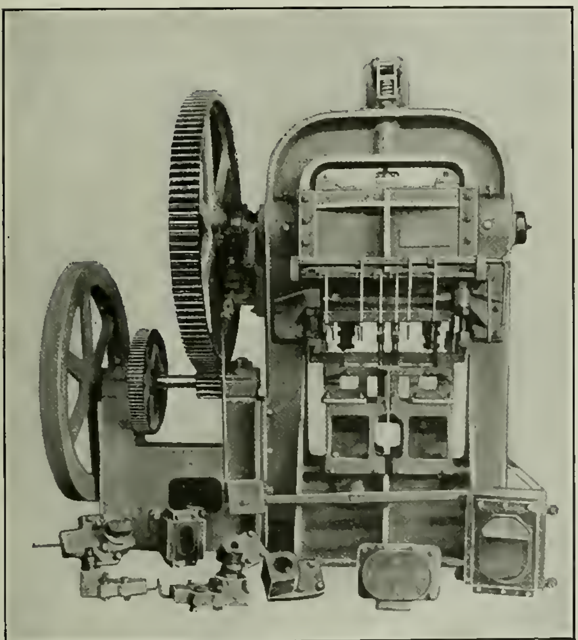


Fig. 1—Car Underframe Type Multiple Punch with Interchangeable Special Tools

The demand for a punching machine with a wide range of application, such as is found in the steel car shops, was responsible for the design, or perhaps it may better be said, the development, of the machine here described. The punch with several of the interchangeable punching and blanking-out tools and dies is shown in Fig. 1. This machine was built for one of the large tank car companies. Its utility and capacity are greatly increased when it is operated in conjunction with a spacing table, as described in subsequent paragraphs.

Steel car underframe work requires punching, shearing and sometimes coping and blanking-out of plates or structural sections. In some cases the structural sections are made by flanging flat plates, which are punched most readily before being flanged. Tool set-ups suitable for these operations are shown in Figs. 2 and 3. With other tools and spacing blocks to suit, angles up to 6 in. x 6 in. x 5/8 in. can be punched singly or in pairs, the latter method having the advantage that, with the clamping device illustrated in Fig. 1, the angles are held back to back, and the tendency to curling is overcome and the holes are uniformly spaced with reference to the heel of the angle. Likewise, I-beams up to 6-in. flange and 15-in. web and channels of corresponding dimensions can be punched on either the flanges or web, the channels for flange punching being handled in pairs as though they were an I-beam, by means of the automatic, cam-operated clamping device illustrated in Fig. 1. In punching channels, the web is always punched first. For punching the webs of beams and channels, guide rollers

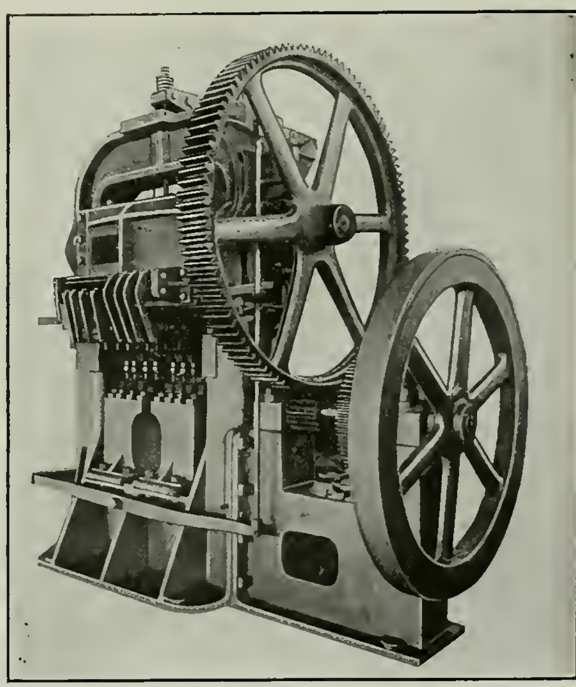


Fig. 2—Punch Equipped with Tools for Multiple Punching of Plates

are mounted on the punch blocks in the same way that the die holders are held in place, that is, by means of T-head bolts. Z-bars are also handled in pairs with a special set-up, for either web or flange punching. For this work, high and low die holders, and long and short punch spindles are required. As the clearance between housings is approximately 39 inches, plates or sills up to 36 inches in width can be punched.

The design of this tool is such that it can be fitted up very readily with coping tools, or it can be converted into a gate shear, guillotine type shear, angle and channel shear, or bar shear.

The adaptability of this multiple punch for use in connection with a spacing table is shown in Fig. 4, in which the spacing carriage (of the hand-operated type) is shown in the foreground in place on the roll table. The trailer carriage, for guiding the trailing end of the plate or other member while going through the punch is shown somewhat indistinctly on the far end of the roll table. The movement of the spacing carriage in advancing the plate through the punch can be made entirely automatic by the use of a motor mounted on the carriage and driving through a clutch arrangement and gear train to the pinions that are to be seen in the illustration adjacent to the carriage wheels. However, as the rollers of the roll table are all equipped with ball bearings, the heaviest plate can be moved by hand with remarkable ease.

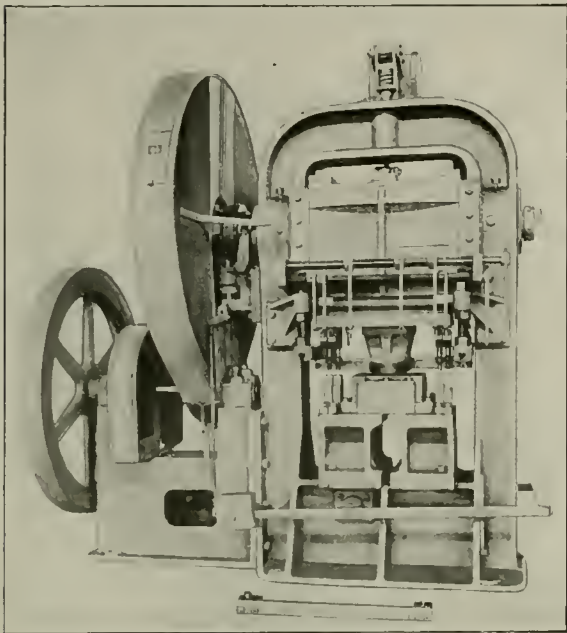


Fig. 3—Set-Up of Tools for Blanking Out Web of Channel and Punching at Each Side in Pairs

Whether motor or hand driven, the spacing between holes or rows of holes, as the case may be, lengthwise of the plate, is automatically controlled by means of a full-sized templet which is fastened to the side of the roll table by means of clamps. This templet is simply a wooden strip, which can be prepared in the pattern shop, having steel pins driven in at intervals corresponding to the pitch between holes, measured lengthwise of the plate. The drawing for the punching layout is used in making this templet which is thereafter identified by being marked with this drawing number. These steel pins on the templet simply serve to actuate the tripping mechanism on the spacing carriage, which in turn releases a set of pawls that drop by gravity into the spacing rack mounted on the framework of the table. The operation of these pawls is electrically interlocked with the operation of the ram of the punch, so that when the pawls are down in the spacing rack, locking the carriage where it is stopped, the punch can then operate, and as soon as the punching tools strip the plate a cam-operated contact on the main cam shaft of the punch closes the circuit to the solenoid shown in Fig. 4 mounted on the carriage, which operates to lift the pawls out of the spacing rack and thus allows the carriage to advance with the plate to which it is clamped until the next spacing pin on the templet again causes the carriage to stop while the punch makes another stroke.

The standard punching tools can be set to a minimum of 2-inch centers, and may be controlled singly or in groups. Thus, the number of holes punched at a time across the plate with each stroke of the punch is under the control of the operator by means of the hand levers which operate the gags in the respective punching tool holders. This is shown most plainly in Fig. 2 in which the gags for the eight punching tools are seen to be linked up to the arms mounted on the two horizontal operating bars in two groups of four each. In Fig. 3, a different grouping of gag controls is shown. The two middle arms on the upper bar are idle; the third arm operates the gag for the inner tool on the right-hand side. The other three tools are controlled by the lower gag-operating bar. With hand-operated gag control, the operator has to be on the alert to work the proper combinations of gags to give the required punching layout for each successive position of the plate as it advances through the punch.

A method of automatically controlling the operation of

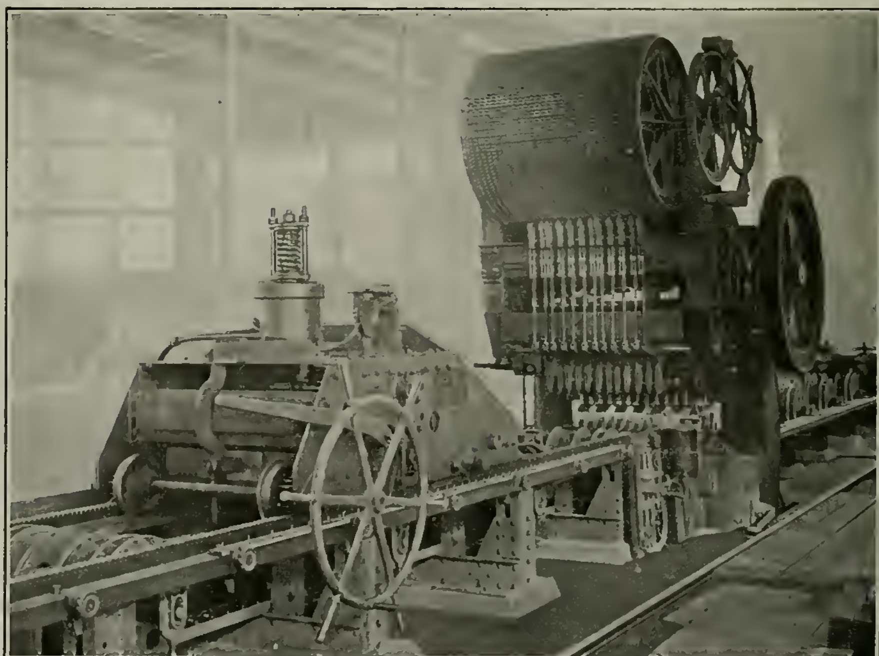


Fig. 4 30-Inch Automatic Spacing Table, and Punch Equipped with Gag Control Mechanism

the gags is shown in Fig. 4. The drum is driven through a gear train from the main cam shaft of the multiple punch. Pins properly located on the drum operate through the vertical connecting rods to throw the gags in and out of the tool holders. With this automatic gag control in operation on a multiple punch also equipped with an automatic spacing table, it is possible to put through the most complicated punching layout without the possibility of errors due to mistakes of an operator, and, moreover, with this full-automatic equipment, it is possible to tune up the equipment to the point of maximum productive capacity without danger of losses due to incorrect operation of the equipment. It will be evident, however, to even the casual observer that the use of full-automatic equipment such as this presupposes quantity production of standardized punching layouts, although it is a comparatively simple matter to change over the complete set-up of the punches and dies, gag control, and spacing templet for an entirely new punching layout, only a short time being involved in making the change.

The two side housings of this multiple punch and the top yoke are cast as a unit, the bearings for the main cam shaft being carried in the side frames without splitting the bearing housings. These babbitted bearings are carried in solid bronze shells, one of which has an outside diameter such as to allow the cam shaft, with the cam forged solid thereon, to be threaded through the housing in assembling the machine. After the cam shaft is in position the bronze bearing shell is slipped over the shaft and into place, where it is securely locked.

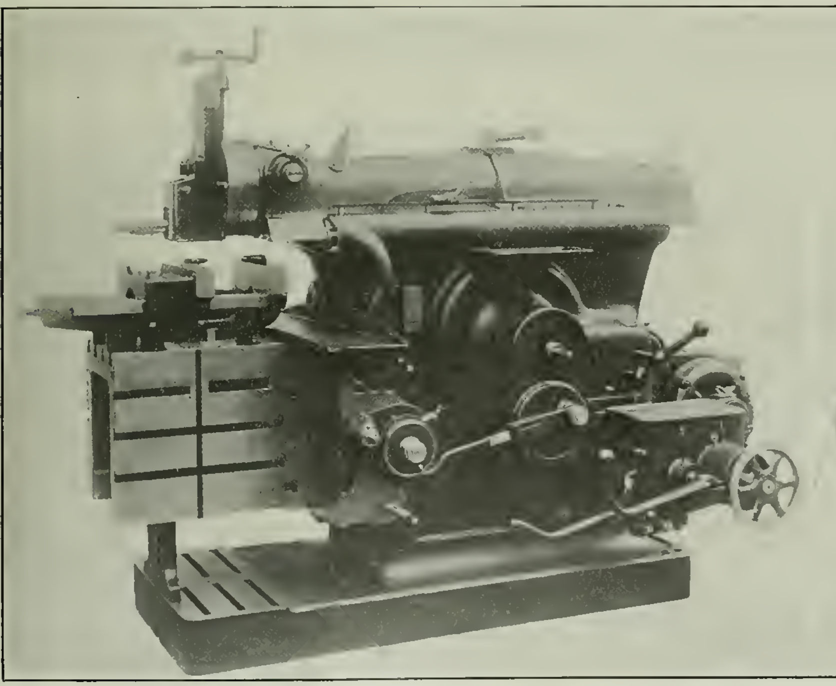
The advantages of this construction are, first, the extreme rigidity of the frame in comparison with the ordinary open throat or "C"-type punch used for the same work; second, lighter weight, which justifies the use of cast steel instead of cast iron for the frame, thus introducing a much higher factor of safety; third, much smaller floor space required for the punch; fourth, greater strength with a one-piece frame casting than with frame made in sections and bolted together; fifth, the tension strains are carried in a straight line from the shaft to the base, thereby insuring maximum strength and rigidity, which in turn results in longer service from the punching tools and dies.

The capacity of the punch here illustrated, which is designated as a No. 14 machine, is 450,000-lb. ram pressure, or in other words a capacity for punching a 2-inch hole in 1¼-in. plate, or its equivalent, and for shearing flats up to 8 in. x 1¼ in., and rounds up to 2¾ in. The ram has a travel of 2 in., and at normal speed makes 26 strokes per minute. This machine requires a 10-H. P. driving motor.

CONSTANT SPEED MOTOR DRIVE FOR SHAPER

Gould & Eberhardt, Newark, N. J., have designed what is known as a selective type gear box, with steel case-hardened gears, which may be used with a constant speed motor drive or a single pulley belt drive, giving the same changes of speed as are ordinarily obtained with the cone pulley drive. It is unnecessary to stop the machine in changing speed except when changing from single gear to back gear, or vice-versa.

A 10 h. p., 1,200 r. p. m., constant speed motor is used on the 28-in. Invincible shaper shown in the photographs. This machine, by the way, will be exhibited at the mechanical conventions at Atlantic City. Eight changes of speed may be obtained for every change in stroke. Some idea of the proportions of the gear box and the motor and of the relative location of the control levers and wheel on the operator's side of the machine may be obtained from the photographs.



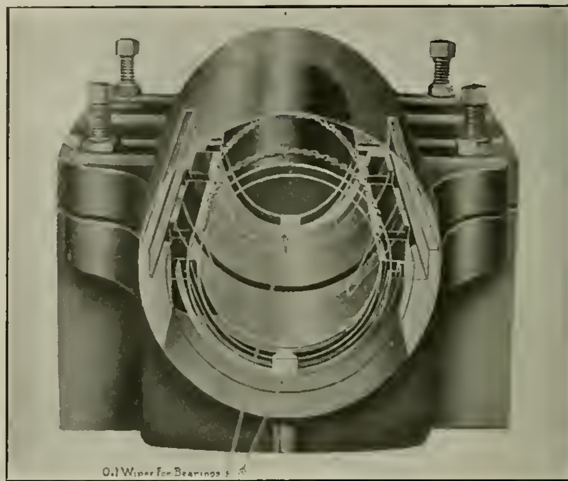
(Left) Operator's Side of Machine Showing Application of Motor and "Selective Type" Gear Box. (Right) Partial Rear View.

The shaper has a range of cutting strokes of from 9 to 115. The maximum stroke is $28\frac{3}{4}$ in. and it planes for a width of 29 in. The maximum distance from the table to the ram is $17\frac{1}{2}$ in., and the minimum distance is $4\frac{1}{4}$ in. The head has a vertical movement of 8 in., while the table has a similar movement of $13\frac{1}{2}$ in.

AN OIL CONSERVER FOR BEARINGS

An improvement in the application of oil wipers for bearings is shown in the illustration. It consists of a tempered steel spring with a triangular shaped piece of babbit metal mounted on the end. The babbitt is shaped to the shaft and wipes the shaft clean, returning the oil to the reservoir of the bearing. The spring is fastened to a convenient point in the groove at the end of the bearing or to the housing. A wiper is placed at each end, and it is stated that it will hug the shaft under all conditions even if the bearing wears or the shaft thins so as to normally pull away from the wiper. Reversing the direction of the shaft will not decrease the effectiveness of the wipers, which are furnished for all plain roller or ball self-oiling bearings.

These new oil wipers are manufactured by the Industrial Products Company, Detroit, Mich. The makers state that bearings equipped with these wipers have been in satisfactory service for over two and a half years; tests and records show that the saving in oil required for replacement has been not less than 85 per cent on line shafts 6 inches in diameter and upwards. On tests run for the last four months on 10 bearings, each transmitting 250 h. p., there has been required one gallon of oil for replacement on all 10 bearings.

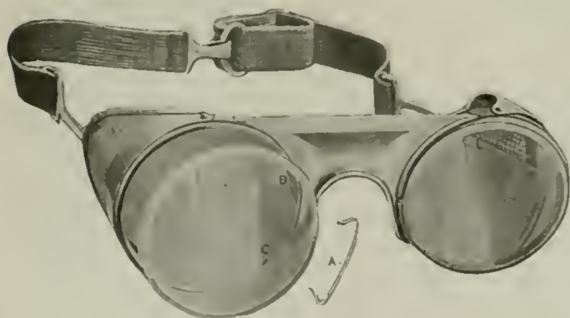


Oil Wiper for Bearings

EYE PROTECTORS FOR SHOP AND LOCOMOTIVE MEN

Protection for the eyes of enginemen and firemen, riveters, grinders, foundrymen, electric and gas welding operators and other shop men whose duties require the wearing of goggles is provided by the Insula Welda Eyetects and the Resistal Industrielle Eyetects which are shown in the illustrations.

The lenses of the Resistal Industrielle Eyetects are quickly changeable by the removal of the lock wire from the holes in the frame. The bridge is wide and is said to rest comfortably on the nose; it is provided with a lip at the top which protects the eyes at the nose. The side shields, which are of perforated sheet nickel-silver, are hinged and fold easily; they afford ventilation and prevent the entrance of dust. The goggles are held in place by an adjustable elastic strap which is light and comfortable.



Resistal Industrielle Eyetects, a Safety Goggle

The Insula Welda Eyetects are made specially for welding operators and contain removable colored Resistal lenses, for which it is claimed no harmful glare can penetrate, yet provides a perfect vision for the operator. The nose bridge is an adjustable strap. The shield has five ventilating holes behind the lens cap to admit air. There are also four compression slots on the circumference of the shield which make it possible for the lens cap to be slipped over the shield and be held in place by friction. The elastic also serves to hold the friction cap snugly in place regardless of the thickness of the lens. This construction makes it possible quickly to remove and replace the lenses while the goggles are in use.

A Goggle for Welders, Known as the Insula Welda Eyetects

Both goggles are provided with lenses of non-shatterable glass known as Resistal, a combination of double glasses with a layer of transparent celluloid between them, which has satisfied an official government test conducted by the Bureau of Standards as to its safety features. The following sentence is taken from one of the Bureau's reports: "In view of the tenacity with which celluloid holds glass and prevents it from shattering, the slightly lower light transmission of such a combination is probably compensated by the superior protection offered to the eyes in case of accident to the goggles."

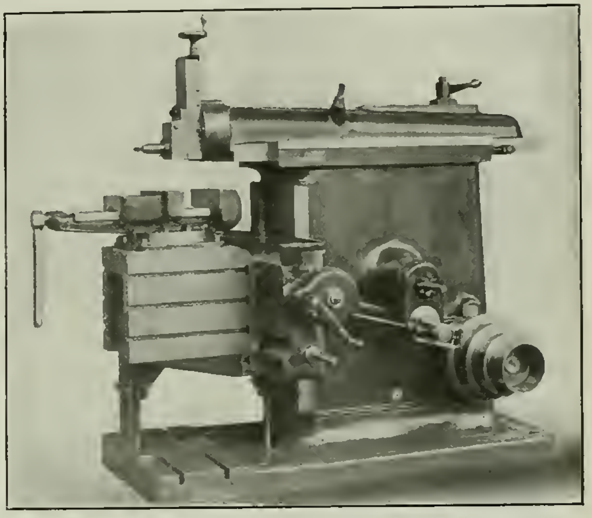
These goggles are manufactured by Strauss & Buegeleisen, New York City.

20-INCH BACK GEARED CRANK SHAPER

The Springfield Machine Tool Company, Springfield, Ohio, has added to its line of shapers a 20-in model, which is similar in all respects, except size, to its 25-in. back geared crank shaper. The column has well rounded corners and is internally ribbed; the ram is exceptionally long with ample bearing surface. The tool head has a long travel and has a down feed screw with a micrometer collar attachment. The tool block feeds 9½ in. in any direction, and the size of tools used is ¾ in. by 1½ in.

The 15¼-in. by 20-in. table has a transverse movement of 32 in. and a clearance of 17 in. from its top to the ram. The cross-rail is long and deep and is elevated by means of a telescopic screw provided with a ball bearing thrust. One gib is provided with an angular rear face, so that the cross-rail is always kept square with the column. The cross-rail is provided with automatic cross feed in either direction and the cross feed screw has a micrometer collar.

The cross slide has an extra large bearing surface on the cross-rail. The vise is clamped to the table and revolves upon a graduated index plate which is keyed to the table. By means of an index pin it can be readily locked at right angles or parallel with the ram. The vise jaws are lined with steel and provided with a tension screw. The crank gears are made with large pitches and wide faces. The stroke arm is connected to the ram by means of a link, providing ample space to allow a 4-in. shaft to pass entirely through the column for keyseating or any other similar operation. The stroke is varied from a convenient point and adjustment is possible while the machine is in motion. Eight speeds are provided and the number of strokes per minute varies from 7 to 129. The machine occupies a floor space of 56 in. by 136 in. and weighs 4,850 lb.

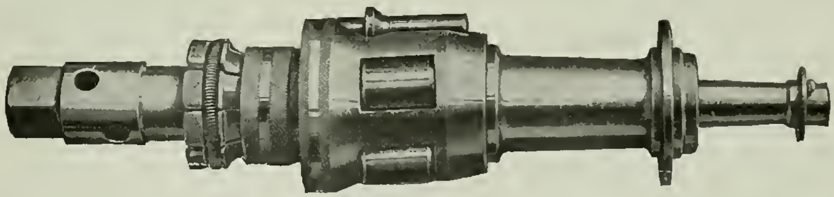


Springfield 20-in. Crank Shaper

DOUBLE UTILITY TOOL FOR BOILER TUBES

The self-feeding flue expander illustrated is designed to "finish the job" by flaring the end of the flue before the expander is withdrawn; it saves the time required for flaring with an additional tool in a different operation. When the expander has been inserted into the flue to the point of the flaring part of the flaring roller, the mandrel is turned to the right and the flue is rolled tight in the sheet. To obtain the flare the mandrel stop is placed against the cage, which prevents the mandrel from entering the expander further, and then by continuing to turn the mandrel to the right the expander is forced further into the flue and the flare is produced. To remove the expander the mandrel is turned to the left. It is stated that a perfect job of rolling flues tight in the sheet can be performed, and that any angle of flare up to 45 deg. can be made.

This tool is known as the locomotive superheater expander and is made in several sizes, for 4½-in., 4¾-in., 5-in. and 5½-in. flues, by the J. Faessler Manufacturing Company, Moberly, Mo., who also manufacture a similar tool for locomotive arch tubes and water tube boiler flues. The latter, in sizes ranging from 2½ in. to 4½ in., are provided with collars which are adjustable up to a maximum distance of 10 in. or more between the base of the collar and the center of the rollers. In operation, the adjustable collar on the cage shank is set back from the outside sheet to the distance the tube projects from the inside sheet and then the operator proceeds exactly as with the other tools, already described. These tools do not pinch or thin the tube at the bottom of the flare and the outside edge of the sheet; these parts are left the same thickness as the body of the tube.

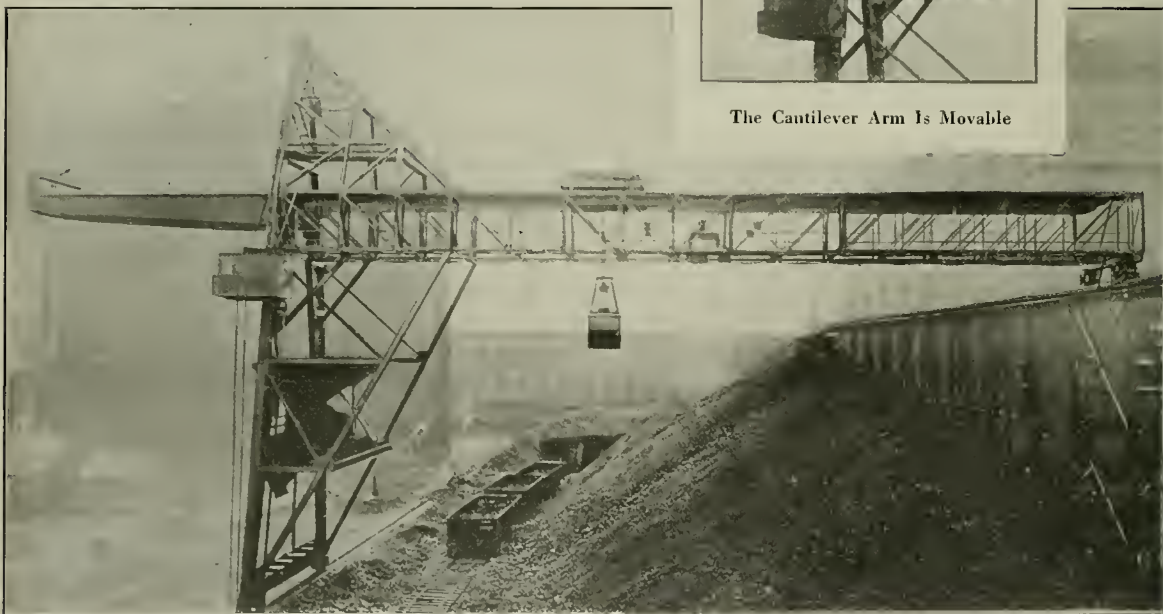


Tool for Expanding and Flaring Tubes

AN EFFICIENT COAL HANDLING APPARATUS

TWO HUNDRED AND FIFTY tons of coal per hour is shown in the illustration. It is adapted for the han- the rated capacity of the gantry type bucket crane dling of ashes, cement, clinker, crushed rock, stone, slag, sand, gravel and other loose materials. The span between the rails in the installation shown is 138 ft. 9 in. The effective cantilever is 43 ft. 9 in.; the over-all height of the gantry leg is 97 ft. 3 in., and the lifting speed of the bucket is 320 ft. per minute. Coal is crushed before it is delivered to the power house by a 250-ton capacity crusher attached to the gantry leg. The cantilever leg is movable and can be drawn up out of the way at places where there is not sufficient clearance. The installation shown was manufactured by the Whiting Foundry Equipment Company, Harvey, Ill., manufacturers of a line of industrial cranes and hoisting apparatus, including special types adapted for railway cinder pits.

The Cantilever Arm Is Movable



Whiting Bucket Crane, Gantry Type; Capacity 250 Tons Per Hour

VAPOR AND MOISTURE PROOF ELECTRICAL FITTINGS

THE Appleton Electric Company, Chicago, Ill., has added several weather-proof, and vapor and moisture proof fittings, to its line of "Unilet" conduit fittings. These fittings are particularly suitable for service in roundhouses, power plants, boiler rooms, tunnels, oil houses, and in any place where the switch or the light is exposed to weather, to locomotive gases, or to moisture. The weather-proof snap switch fitting is No. 1 in the illustration. The bridge in the fitting permits of mounting any 5 or 10 ampere snap switch. It is complete with flanged hood, rubber gasket, and all necessary fastening screws. Room is allowed around the switch handle for convenient

Moisture Proof Conduit Switch Fittings and Outlets use. When a lock switch is desired, the switch handle may be removed and replaced with lock attachment. Extension stems are furnished for use with Perkins' switches, but stems for other makes can be furnished if the make is specified.

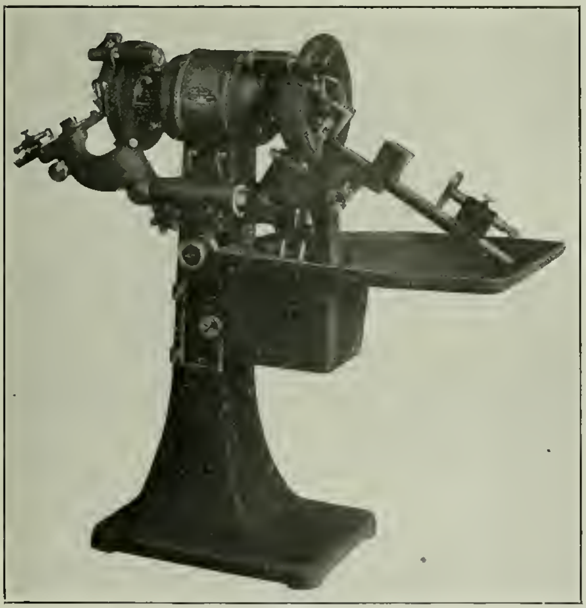
The weather-proof fitting for double push-button switches (No. 2) was designed to protect push-button switches from vapor, gas and dust. The body has four ears to which the cover is fastened. The cover is flanged, and is furnished with a mechanism which operates the push buttons and extends through the side of the dome terminating in an operating handle. That portion of the shaft to which the handle is fastened, passes through a stuffing box. The handle is marked with indicators "on" and "off."

The vapor-proof lamp outlets, Nos. 3 and 4 are fittings so designed that they remain vapor, gas or dust-proof even though the globe may be broken or removed for renewal of lamp. The guards are of the screw type, and do not require the use of a screw driver. These fittings are furnished with receptacles, sealing plates, gaskets and all necessary screws, and with or without globe and guards.

The weather-proof lamp outfit No. 5 is suitable for use in places where a small, durable fitting is required. It is furnished complete with receptacle, gasket, holder and guard. Brass guards are regularly furnished on this fitting, but steel guards can be furnished if so specified. This type is not made to take vapor-proof globes.

A REFINEMENT IN TWIST DRILL GRINDERS

THAT the agitation for "more holes for less money" has influenced the development of other factors than improved and harder steel for drills and improvement in the design and construction of the machines for driving them, is attested by the results of studies on the proper maintenance of the drills. One of the results is shown in the photograph. This is a double holder drill grinder which contains several new and time saving features, conspicuous among which is the departure from the usual practice by the furnishing of a double holder machine in which is combined a small minimum capacity convenient in handling small drills, with the necessary capacity for large drills. The smaller holder will accommodate drills from No. 52 to ¾-in., while the larger one will handle drills up to 4 in. or more. The larger holders grind the large drills wet and use a coarse wheel. The small drills are ground dry on a fine grain wheel.



Motor Driven Double Holder Drill Grinder

In grinding drills on this machine the rotation of the wheel is downward from the point of the drill, thus obviating a tendency for the drill to lift from the holder, as well as throwing all grit downward, resulting in safety for the operator's eyes.

Extra weight has been incorporated in the main frame or column to provide for rigidity. The spindle is furnished with a ring oiled bronze bearing. Radial wear and end play are provided for and the bearing is made dustproof through the use of felt washers. The wheel guards are mounted on the stand by three substantial supports. The wheels are carried between heavy flanges to lessen danger, increase rigidity and insure good grinding results.

The lip rests furnished with these machines are flat strips of hardened steel of uniform width and thickness with slotted holes, by means of which they are held in position on the front of the holder; the screws hold them not only against the front of the holder, but automatically bring the back edge against the shoulder, which is machined in a line parallel to the correct position for the front edge. The shape is so simple that it is stated that if one of the lip rests becomes lost or damaged it can be duplicated without difficulty. A comparatively long life for the lip rests is made possible by the fact that they can be reversed, the front edge being substituted for the back edge.

An important improvement is incorporated in the wheel truing mechanism. A wheel truing diamond is carried in a member attached to the hood of the wheel which is adapted to swing across the face of the grinding wheel. The carrier for the diamond and a stop are moved in unison across the wheel by the turning of the knurled nut on the end of the spindle, which is seen just in front of and near the top of the motor in the photograph. Whatever amount is dressed off by the diamond will be automatically taken care of by the new position of the stop and when the drill holder is again brought in front of the wheel a perfect setting is obtained.

The swiveling action provided for grinding the drill is accomplished by the use of a ground stud 1½ in. in diameter by 4¼ in. long on which is journaled the cast iron swivel head with a bronze bushing bearing on the full length of the ground steel stud. The top of the bearing is covered with a plate for the exclusion of dust and dirt from the bearing surfaces. A grease cup lubricates the swivel bearing.

The grinder is particularly adapted to take care of high speed steel drills which are welded or screwed into machine steel shanks, where frequently the shanks are considerably larger than the drill. A special drill holder has been designed for left hand drills.

To accommodate the differences in the amount of clearance required on different classes of work, provision is made for rocking the drill holder in the upper swivel bearing, which rocking adjustment is controlled by turning a knurled handwheel operating a differential screw.

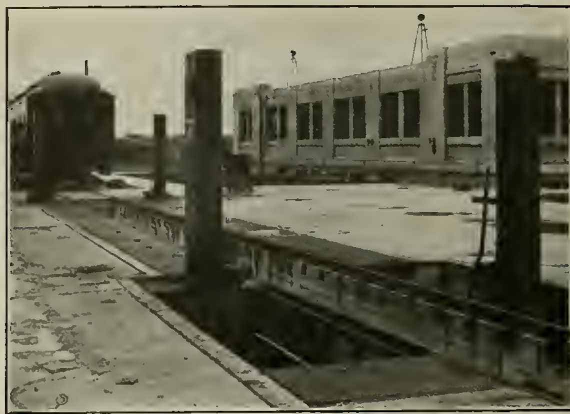
This double holder drill is characteristic of the line of grinding machines manufactured by the Grand Rapids Grinding Machine Company, Grand Rapids, Mich., who will exhibit the style C-6-A grinder mentioned, with several other models, at the June mechanical conventions at Atlantic City.

QUICK-ACTING DEVICE FOR UNWHEELING COACHES

THE successful application of the principle of raising locomotives for unwheeling by means of permanently installed, electrically operated screw jacks lifting from the floor, has been extended to the car repair tracks and the illustrations give some intimation of the speed, cleanliness and general efficiency in jacking up cars preparatory to rolling out the trucks from both ends.

The electric controller box is at the right of the first pair of jacks in Fig. 1. The upright members of the jacks are spaced a fixed distance apart laterally. The near pair have the floor boards removed to show the mounting of the jacks upon a truck, which provides for adjusting their spacing longitudinally for the different lengths for cars.

The heavy steps or knees on the jacks travel between the jaws or flanges of the cast steel column or post. Each is controlled by a revolving screw, and provision is made for raising each step to the sills of the car independently; then all four jacks can, by throwing a clutch, be controlled as a unit. The equipment is manufactured by the Whiting Foundry & Equipment Company, Harvey, Ill.

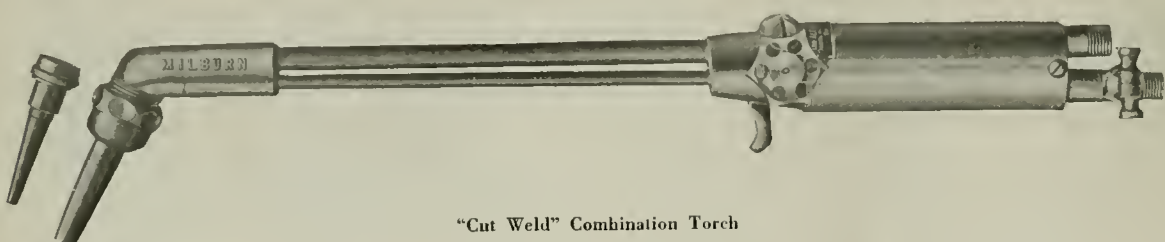


Jack for Unwheeling Coaches

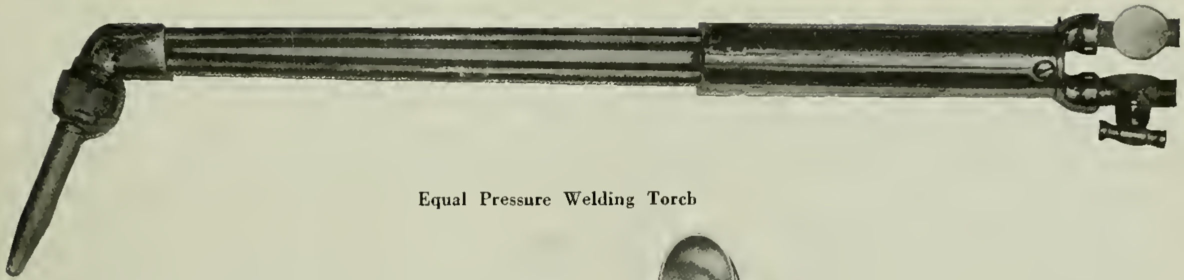
Coach Raised Sufficiently for the Trucks to Be Removed

A CARBIDE LAMP AND WELDING TORCHES

THE new 5,000 candle power carbide lamp illustrated herewith is said to be able to throw a strong light from a 12-in. white enamel reflector for 12 hours with the use of 8 lb. of carbide—a cost of approximately 3c. an hour. It is equipped with a vanadium steel burner cleaner which operates from the rear while the light is burning. The container is equipped with shelves or pockets (see A) which will accommodate the rated carbide capacity of the container and no more; it has the added advantage of facilitating the quick disposal of the used carbide which can be easily dumped by



"Cut Weld" Combination Torch



Equal Pressure Welding Torch

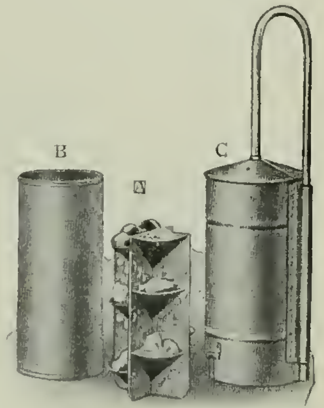
simply withdrawing the container and tapping it on the edge. The light has 10,000 candle power. It burns over 12 hours on 12 lb. of carbide, at a cost of 4 cents per hour.

The lamps are the product of the Alexander Milburn Company, Baltimore, Md., who manufacture a general line of carbide illuminating apparatus, as well as oxy-acetylene torches for welding.

The "quick-weld" torch, type J, illustrated herewith, is an equal pressure oxy-acetylene torch for welding and has only recently been produced by the same company. In this torch the gases are mixed in the tip and each size of tip has its own mixture. The torch head and tips have a flat seat which insures a perfect fit at all times, a new tip fitting the old torch without difficulty. It is provided with five different sizes of tips and is equipped with union hose couplings. This torch is known as the equal pressure welding torch because the oxygen and acetylene are used at equal pressures; this is said to make a softer flame and prevent danger of oxidation of the metal through an oversupply of oxygen; the torch is said to be non-flash-back.

The "cut-weld" torch, also illustrated, is also a new product and is an all-purpose torch with interchangeable tips which can be used for cutting or welding as the case requires.

Carbide Light



Parts of Carbide Container

OIL STORAGE AND PREVENTION OF WASTE OF OIL

THE bung stopper, shown in the illustration, is so constructed that it may be tightly fitted in the bung hole of a barrel whose contents may then be transferred to storage tanks without the loss of a drop of oil.

The threaded main stem through the center of the body of the bung stopper, is connected to the two upturned fingers which rest against the inside of the barrel. The fingers are pivoted to the stem in such a way that they can readily be slipped through the bung hole. By tightening the hand screw at the upper end of the stem, the bung stopper is clamped to the barrel at the bung hole. When the stopper has been placed directly over the fill opening the sliding gate on the outlet of the stopper is opened. The bung stopper is a standard attachment furnished by the Milwaukee Tank Works, Inc., Milwaukee, Wis., who are also manufacturers of the storage tanks illustrated.

The battery of tanks placed in series forms an ideal method of handling oils of different kinds. All the dimensions of the tanks are the same, except for the width which varies according to the capacity. Tanks of various capacities may therefore be placed in the same series without disturbing the uniformity of appearance. The pumps which are furnished with the tanks are of standard self-measuring designs. An 18 in. manhole affords easy access for cleaning or inspection.

Bung Stopper Designed to Prevent Waste of Oil

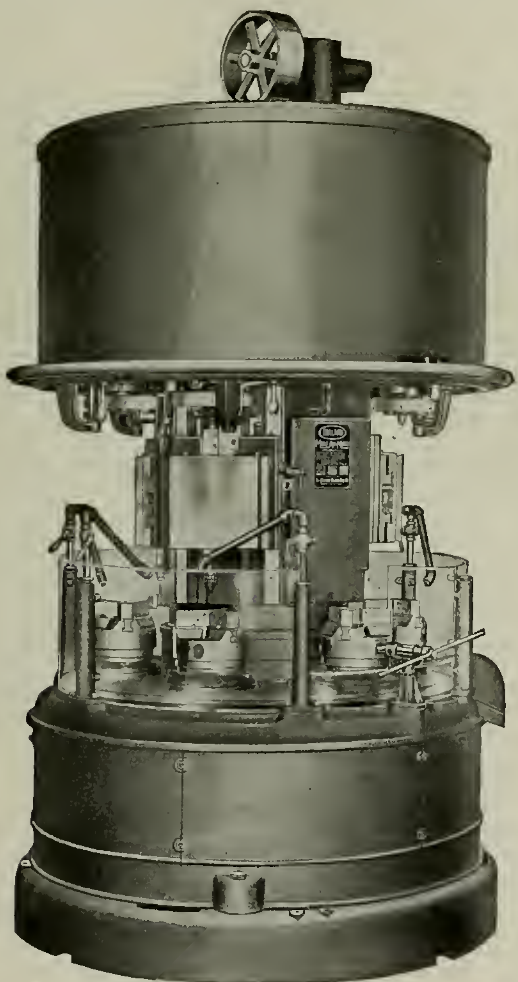
Tanks of Different Capacities But Uniform Appearance May Be Placed in Series

A BORING MILL THAT IS SIX MACHINES IN ONE

A MACHINE that is a self-contained, fully equipped factory, capable of producing the highest grade of work, correct to within a thousandth part of an inch, marks the advanced stage of multi-spindle boring mills which has been achieved in the "Mult-Au-Matic."

This machine will be exhibited in operation at the June mechanical conventions at Atlantic City with a new vertical turret lathe and the Maxi-Mill, a development of the 2-spindle boring mill, by its designers and manufacturers, the Bullard Machine Tool Company, Bridgeport, Conn.

The Mult-Au-Matic illustrated in the photographs is six engine lathes in one machine, each working in sequence and operated by one man, whose only duties consist of loading and unloading. There are five working stations, each of

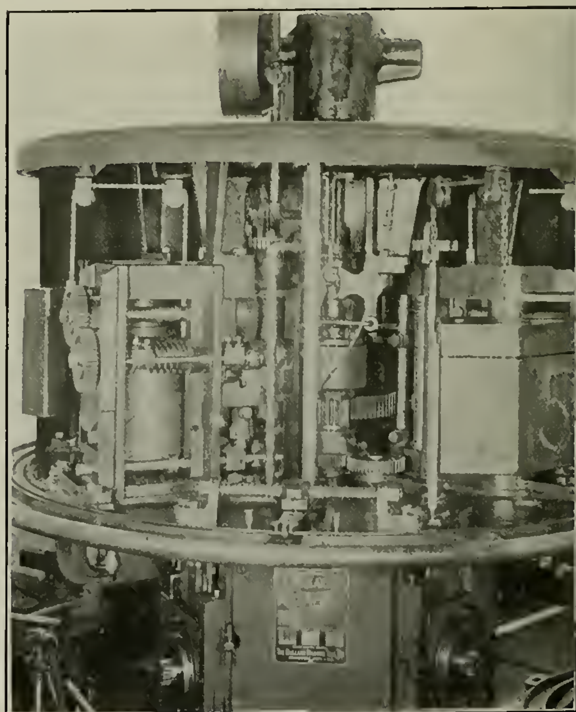


Bullard Mult-Au-Matic

which impresses the onlooker as being an engine lathe standing on its head, and working the better because of the new position, for all the humanly operated lathe motions are followed out without the mind or hand of man to guide and with slight possibility of human lapses in time and accuracy.

The field of the Mult-Au-Matic includes all classes of castings, forgings, or bar-stock sections, cut to length, coming within its capacity, and which require boring, turning, facing or threading operations, either singly or in combination. It comprises six independent vertical lathes automatically operated in combination on a series of pieces of the same form and size, all of the sequence of operations, including chucking, being performed simultaneously. Thus there is produced a completely finished piece in the time required for the largest operation of the sequence plus the few seconds needed for the indexing of the carrier and its spindles from one station to the next. The six independent work-holding spindles are mounted on a carrier, or turret, which revolves around a central column having six faces, the first of which, being the loading station, is blank. On the remaining five faces are mounted tool-carrying slides which are independently adjustable in amount, rate and direction of movement.

The cylindrical base is divided into two sections, the lower of which serves as a tank of large capacity for cutting lubricant or "Coolant" and the upper as a reservoir for the lubricating oil circulated throughout the machine. On its lower

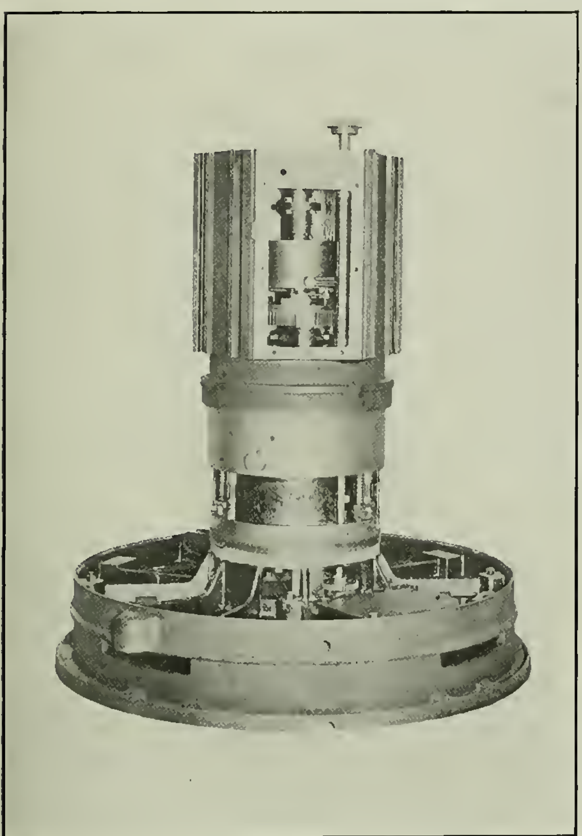


Inside View of the Upper Story of 8-Inch Mult-Au-Matic with Metal Splash Guards Removed

end is found the main, or central, bearing for the spindle carrier, or turret. This section contains the indexing or turret registry mechanism and is illustrated herewith showing an inside view of the upper section, with the sheet metal guard removed revealing the main drive shaft, the outside hand-controlled clutch ring, work spindle drive, feed change gears, quick return cam on feed head, and a view of a counterweight on one of the stations of the machine.

On its upper end are mounted the independent tool-carrying heads, and on the head of the column and firmly secured thereto is mounted a strongly ribbed base for the feed and driving mechanism.

The work spindles, in type and proportion, are somewhat like those used in the Bullard boring mills and vertical turret lathes. Means for obtaining widely variable independent selective speeds for the work-carrying spindles are provided at each station. Speed changes are made through the transformer gears, located at the head of the column.



Base and Hexagonal Column Showing Controller Drum, Locking Pin and One of the Work Spindle Driving Pinions

The carrier is rotated from station to station by power. The tool-carrying heads are mounted on the faces of the column at the five work stations. These heads are entirely independent in direction, amount and rate of movement, and consist of a main slide gibbed to the column, on which is mounted a secondary slide to which the tool combination can be secured. The secondary slide may be swiveled to 90 degrees either way of the work axis and rigidly located at any angle.

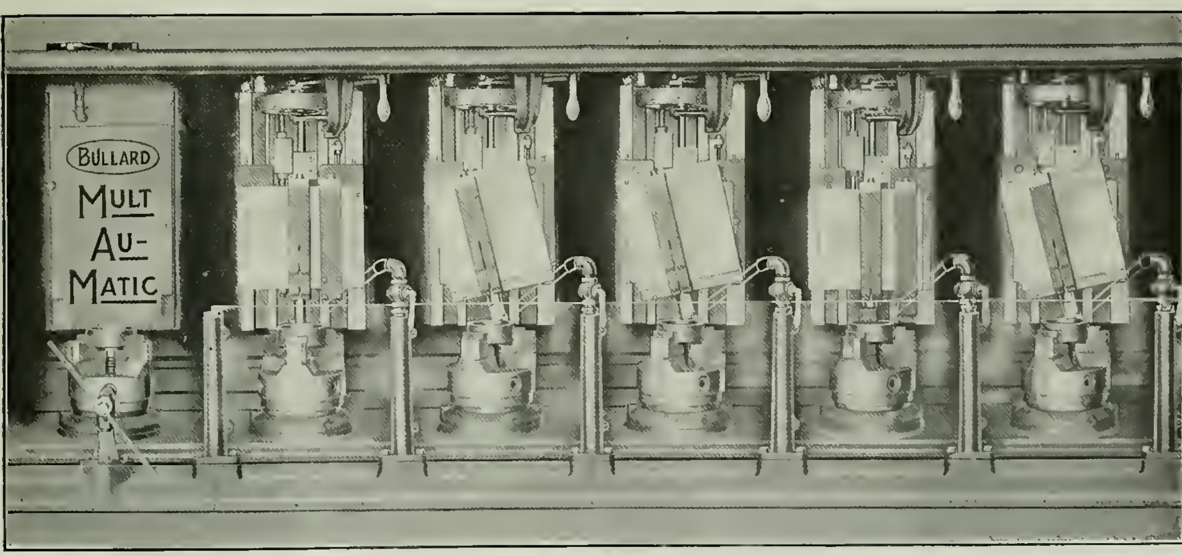
For straight boring, reaming and turning, the secondary slide is locked at zero and the entire head moves as a unit throughout the distance required to complete the operation, meets its stop and is returned.

For taper boring—an example of which is shown in one of the illustrations, a developed view of the six heads—angular turning or facing at any angle with the work axis the secondary slide, which is fed the distance required, is brought to rest by a stop and locked in position. The motion is then taken up by the secondary slide, which is fed the distance required, brought to rest by an adjustable stop and returned through its original path. The heads are rapidly advanced to the point where feed should begin, the feeds then engaged at the predtermined rate per revolution, and at the completion of the feed movement are rapidly returned. The rate of advance and return is constant regardless of feed or spindle speed, but the point of change from rapid advance to speed is adjustable.

Each tool head has also an independent manual control, saving time in the setting up of a job. The time element of all automatic motions is therefore constant and cannot be varied or adjusted by the operator.

The Mult-Au-Matic operates on a principle that makes the total time for machining a piece on it the time of the longest single operation. A feature that promotes flexibility of set-up and at the same time decreases the expense of tool equipment is the use of traverse and angular feeds. The necessity of sweep cutters for facing is done away with.

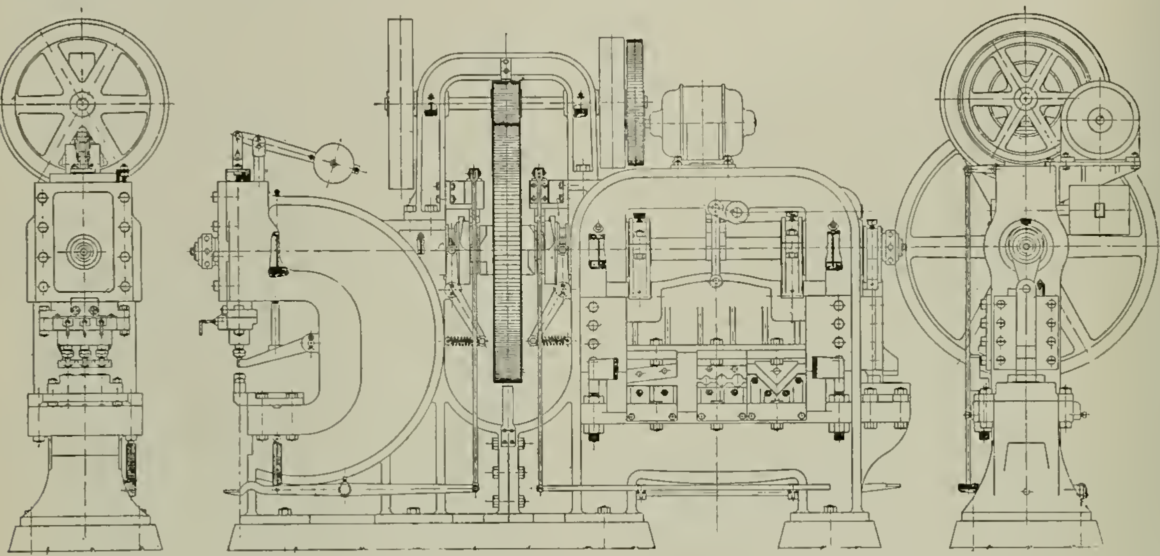
Some idea of the remarkable savings brought about by this machine may be had from the experience of a manufacturer of international renown. In his plant a Mult-Au-Matic has cut the total time for a series of different machining operations on a certain piece from 15 minutes to 2 minutes and 15 seconds. In addition to this saving in time, the work is of higher and more uniform quality.



Developed View of the Loading Station and Five Working Stations, Showing the Mult-Au-Matic Tooled for Machining a Conical Roller-Bearing Race

COMBINATION TOOL FOR THE STEEL CAR SHOP

As evidence of an increasing tendency in the construction of machine tools which, constituting one unit only, are designed to do the work of and supplant two or more independent installations, a recent addition to the motor-driven heavy punch and shear line is shown in the illustration. It was specially designed for use in car repair shops.



Combination Punch and Shear Especially Designed for Steel Car Repair Work

The left hand or punching end of the machine is equipped with a semi-steel architectural jaw for handling structural shapes; the throat depth can be furnished in any required practicable dimension. Three different sizes of punches can be set up simultaneously and each may be operated independently at the option of the operator. The right hand end of the machine comprises a semi-steel guillotine frame supporting and operating three different types of shears; one for flat work, one for different sizes of round bars and another for angle irons, while the extreme right end of the machine contains a set of coping tools. Seven sets of tools, each set ready for instant use, constitutes the working range of this interesting combination; it will be recognized that in overcoming the loss of time incident to the setting up of various tools as generally required in the operation of the simple double-ended punch and shear, a marked advantage has been gained. The frame of the machine is of semi-steel; the bearings are of phosphor bronze with ring oilers; the clutches are fitted with automatic release.

This machine, furnished in several sizes, will be exhibited at the June mechanical convention at Atlantic City by its manufacturers, the Beatty Machine & Manufacturing Company, Hammond, Ind. It is arranged for motor drive, as indicated in the drawing, all of the driving mechanism being mounted on the head.

HIGH SPEED STEEL COUNTERSINKS

New designs of high speed steel countersinks with three or four flutes are shown in the photographs and are obtainable in 15, 37, 45 and 60 deg. angles of points. One of the photographs illustrates the method of attaching the countersink to the shank. The countersink is firmly screwed and solidly brazed into the taper tool steel shank with a patented Latrobe connection. These tools are the product of the Latrobe Tool Company, Latrobe, Pa., a subsidiary of the Vanadium-Alloys Steel Company, Pittsburgh, Pa.

Latrobe Countersink with Four Flutes

Latrobe Countersink with Three Flutes

These high-speed countersinks were specially developed for use in car building, bridge building, shipbuilding and structural work. It is particularly desirable for work of this character, as well as ordinary shop use, that the tools be made of material of such toughness and hardness that they will stand up under rough usage. These countersinks are said to give maximum efficiency on the hardest material.

Showing How Countersinks Are Attached to Shanks

Railway Mechanical Engineer

(Formerly the **RAILWAY AGE GAZETTE, MECHANICAL EDITION** *with which the* **AMERICAN ENGINEER** *was incorporated)*

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WE GUARANTEE, that of this issue 12,000 copies were printed; that of these 12,000 copies 8,007 were mailed to regular paid subscribers, 80 were provided for counter and news company sales, 202 were mailed to advertisers, 27 were mailed to employees and correspondents, 1,000 were provided for distribution in Atlantic City during the convention of the Mechanical Section, American Railroad Association, 601 for new subscriptions, and 2,083 were provided for samples, copies lost in mail and office use; that the total copies printed this year to date were 52,610, an average of 8,768 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

War Cost of Railway Equipment

For the information of the Liquidation Commission, the office of the chief of engineers has prepared an estimate of the costs of railroad equipment shipped to the A. E. F. computed on the basis of 1914 prices. The government actually paid from two to two and a half times the pre-war costs.

UNIT COST OF STANDARD GAGE RAILWAY EQUIPMENT COMPARED WITH PRE-WAR COST

	Shipped to A. E. F.	Unit price		Actual cost in per cent of pre-war cost
		Pre-war	Actual	
Locomotives—				
Consolidation	1,306	$17,500	$42,966	245
Gasoline	10	9,350	22,000	235
Saddle tank	30	4,500	9,700	216
Total	1,346	....	....	...
Cars—				
Tank	675	$1,367	$3,397	248
Gondola, l. s.	3,429	1,090	2,340	215
Flat	1,900	982	2,107	215
Box	7,299	1,290	2,755	214
Refrigerator	950	1,649	3,489	212
Gondola, h. s.	2,650	1,155	2,430	210
Dump	500	1,026	2,108	206
Ballast	400	1,454	2,987	205
Box, with cab	500	1,366	2,770	203
Total	18,303	....	....	...

COST OF STANDARD GAGE RAILWAY EQUIPMENT COMPARED WITH PRE-WAR COST

	Pre-war cost	Actual cost	Actual cost in per cent of pre-war cost
Locomotives	$23,083,500	$56,524,870	245
Cars	22,346,745	48,822,100	214
Total	$45,430,245	$105,346,970	230

Surplus Military Railway Equipment

The War Department has given out the following statement of the amount and value of property on hand or on order available for sale. The figures are as of May 1:

	Number	Total cost
Standard gage locomotives	197*	$7,540,175
Standard gage freight cars	12,404†	27,621,536
Locomotive cranes	195††	3,924,938
Raised pier cranes	34†	652,960
Track pile drivers	18	603,000
Total	....	$40,342,609

*All on hand.
†None delivered.
††Forty-six not yet delivered.

The locomotive and raised pier cranes will be turned over to the Railroad Administration, by arrangement with the director general of railroads, for sale to the railroads. Under the arrangement with the Railroad Administration the director general will use every effort to dispose of the property to the several railroads at market prices at the time and place at which disposition is made. The incidental expenses incident to the care of the material are to be taken from the proceeds of the sale.

This arrangement also covers about 1,366 tank cars purchased by the Ordnance Department, 100 twelve-yard and 1,320 twenty-yard side dump cars, all of which are fitted to comply with Master Car Builders' and Interstate Commerce Commission standards. In the event of termination of federal control of the railroads before this material is entirely disposed of, the material remaining at the time is to revert to the War Department's possession but in all cases where the material has been sold by the Railroad Administration on the deferred payment plan the War Department will protect such arrangements after the federal control of the railroads ceases.

This entire transfer covers approximately $18,000,000 worth of material. The distribution of the property to the railroads will be handled by the director of the Division of Purchases.

The sales of surplus supplies by the department of military railways, as reported to the director of sales up to April 25, amounted to $71,104,130, of which $68,993,837 represented rolling stock. The prices received represented the actual original cost.

Record of the Engineer Corps

A resumé of the work of the Engineer Corps of the American Expeditionary Forces has been issued by the office of the chief engineer of the A. E. F. and is included in Engineering Recruiting Circular No. 2 used by army recruiting officers in their campaign for volunteers. The circular states that there were 174,000 engineer troops in the service. Part of the work done by the railway engineering units in this force consisted of the construction of 947 miles of standard gage track and a six mile cut-off at Nevers requiring a bridge across the Loire river, 2,190 ft. long.

Among the accomplishments of this force are listed many records in the construction and operation of military railroads. The light railways of the American Expeditionary Forces handled to February 1, 860,652 tons of freight, of which 166,202 tons was ammunition. In one week the ammunition moved amounted to 10,600 tons, and in five nights 23,135 soldiers were carried on these railways. The daily net tonnage handled in October, 1918, was 8,100 tons. In one week 10,700 tons of rations were handled. At the time of the signing of the armistice 2,240 kilometers (1,392 miles) of light railway were in operation, of which 1,740 kilometers had been taken from the Germans, the balance being newly constructed or rebuilt. On November 11, 165 locomotives and 1,695 cars were available for use. In five hours 135 men laid 14,200 ft. of light railway track. Among the shops erected were 10 buildings at Abainville, with a total floor area of 70,000 sq. ft. Over 2,300 cars have been erected and 140 locomotives have been repaired in these shops.

R. H. Aishton, regional director of the Northwestern region, in a telegram to Northwestern roads states that locomotive builders are urging the placing of orders for locomotives in order that they may keep their shops in operation, and also keep down the overhead cost of the locomotives that have been or will be built. The telegram asks for information as to the number and type of additional U. S. standard locomotives that will be required on lines in this region and whether or not approved by the railroad corporation. If the corporations are not willing to buy the United States standard type they are asked to give the number and the type or types that they will be willing to purchase of their own standard.

The American Railroad Association has moved its Chicago offices from the Transportation building, 608 South Dearborn street, to the Manhattan building, 431 South Dearborn street, where the entire fourteenth floor has been secured for its offices and those of the railway associations which have been merged or affiliated with it. The office of the secretary of the Master Mechanics' and Master Car Builders' associations heretofore in the Karpen building, has been moved to the same building.

The Inspection and Test Section of the Railroad Administration is considering the question of tests of locomotive specialties, such as bell ringers, firedoors and electric headlights, and would be glad to receive full information from the various manufacturers desiring to participate in the tests. Communications should be addressed to C. B. Young, manager, Room 709, 1800 Pennsylvania avenue, Washington, D. C.

MEETINGS AND CONVENTIONS

Western Railway Club.—The Western Railway Club on May 19 elected the following officers: President, G. S. Goodwin, mechanical engineer, C., R. I. & P.; first vice-president, J. Purcell, assistant to federal manager, A., T. & S. F.; second vice-president, E. J. Brennan, superintendent of motive power, C., M. & St. P.; secretary-treasurer, J. M. Byrne, chief clerk to mechanical assistant, Central Western Region; directors, E. B. Hall, assistant superintendent of motive power and car department, C. & N. W.; L. S. Kinnaird, superintendent of motive power, C. & E. I.; W. H. Flynn, superintendent of motive power, Michigan Central.

American Society for Testing Materials. — This association will hold its twenty-second annual meeting at the Hotel Traymore, Atlantic City, N. J., on June 24, 25, 26 and 27. Among the features of special interest to railway men as outlined in the tentative program are a session on preservative coatings, lubricants and containers on Tuesday afternoon; a session on steel and wrought iron on Wednesday forenoon; one on Wednesday evening on corrosion and magnetic analysis, and one on concrete and gypsum, including the report of the committee on reinforced concrete, on Friday afternoon. The convention will close with a joint session on cement and concrete with the American Concrete Institute. This will be held on Friday evening, June 27.

Air Brake Appliance Association.—An organization of manufacturers of air brakes and accessories, for supervising the exhibits in connection with conventions of air brake associations, was formed at a meeting held in the Hotel Sherman, Chicago, May 7. At this meeting a constitution and by-laws were adopted and the name, Air Brake Appliance Association, chosen. The following officers were elected: Chairman, J. J. Cizek, The Leslie Company; secretary-treasurer, F. W. Venton, Crane Company. Members of the executive committee for three years: J. F. Gettrust, Ashton Valve Company; J. C. Younglove, H. W. Johns-Manville Company; J. D. Wright, Westinghouse Air Brake Company. Members of the committee for two years: F. W. Venton, Crane Company; J. H. Dennis, New York & New Jersey Lubricant Company; L. H. Snyder, Joseph Dixon Crucible Company. Members of the executive committee for one year: J. J. Cizek, The Leslie Company; M. S. Brewster, U. S. Metallic Packing Company; D. S. Prosser, U. S. Rubber Company.

Twenty-one supply companies exhibited devices at the Air Brake Association convention this year.

Atlantic City Mechanical Convention.—The American Railroad Association has issued the calendar for the first annual convention of Section III—Mechanical, which is to be held at Atlantic City, N. J., June 18 to 25. The order of business is as follows:

Wednesday, June 18, 9:30 *A. M. to* 1:30 *P. M.*

Prayer; address of welcome by the mayor of Atlantic City; address by the chairman.

Action on minutes of annual meeting of 1918 (M. C. B.); report of secretary and treasurer (M. C. B.).

Appointment of committees on subjects, resolutions, correspondence, obituaries, etc.; unfinished business; new business.

Report of general committee, including announcement of nominations for members of nominating committee; discussion of reports on nominations; standards and recommended practice (M. C. B.); train brake and signal equipment; brake shoe and brake beam equipment.

Wednesday, 3 *P. M.*

Revision of the Rules of Interchange, including consideration of the following reports of committees: (1) Arbitration; (2) Revision of prices for labor and material; (3) Depreciation for freight cars; (4) Revision of passenger car rules of interchange.

Thursday, 9:30 *A. M. to* 1:30 *P. M.*

Discussion of reports on car wheels; standard blocking for cradles of car dumping machines; specifications and tests for materials (M. C. B.); welding truck side frames, bolsters and arch bars; couplers; draft gear.

Questions proposed by members.

Friday, 9:30 *to* 1:30.

Discussion of reports on safety appliances; loading rules; car construction; car trucks; train lighting and equipment; tank cars.

Questions proposed by members.

Saturday, 9:30 *to noon.*

Consideration of rules of order, election of officers, general committee and nominating committee, presentation of badges to retiring officers, etc.

Monday, June 23, 9:30 to 1:30.

Address of vice-chairman; action on minutes of 1918 annual meeting (M. M.); reports of secretary and treasurer (M. M.).

Discussion of reports on standards and recommended practice (M. M.); mechanical stokers.

Paper on "Standardization," by Frank McManamy.

Questions proposed by members.

Tuesday, 9:30 to 1:30.

Discussion of reports on fuel economy and smoke prevention; specifications and tests for materials (M. M.); design and maintenance of locomotive boilers; locomotive headlights; superheater locomotives.

Paper on carbonization in valve chambers and cylinders of superheated steam locomotives, by F. P. Roesch.

Amalgamation of other mechanical associations with Section III, A. R. A.

Questions proposed by members.

Wednesday, 9:30 to 1:30.

Discussion of reports on design, maintenance and operation of electric rolling stock.

Paper on "Use of bronze for valve snap rings and piston surfaces, and for bull rings in large cylinders," by C. E. Fuller.

Discussion of reports on train resistance and tonnage rating; on subjects; on resolutions, correspondence, etc.

Unfinished business; questions proposed by members and closing exercises.

Arrangements have been made for a special train to accommodate railroad men from Chicago and points west who will attend the convention. The train will leave Chicago at 3 p. m., June 16, and will arrive at Atlantic City about 5 p. m., June 17. It will have club and dining cars, 12-section drawing room sleepers and 7-compartment drawing room cars. Requests for reservations on this train should be addressed to C. L. Kimball, 175 W. Jackson boulevard, Chicago.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago. Convention, August 27-29, Hotel Sherman, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, New York, N. Y.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention September 2-3, 1919. Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention, June 18-21, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y.—Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

GENERAL

S. A. CHAMBERLAIN has been appointed superintendent of motive power of the Lake Superior & Ishpeming and the Munising, Marquette & Southeastern, with headquarters at Marquette, Mich.

MAJOR C. E. LESTER of Meadville, Pa., has been appointed general superintendent of the 19th Grand Division, Transportation Corps, of the American Expeditionary Force. He entered the National Guard, 13th Pennsylvania Infantry, in August, 1916, and was commissioned first lieutenant, infantry, in October of the same year. In August, 1917, he was transferred to the engineers. He was appointed captain, engineers, in the National Army in April, 1918, and commanding officer of the 50th Engineers, with which he went abroad in July, 1918. Upon his arrival in France he was appointed general foreman at the Nevers locomotive shops, operated entirely by United States soldiers. He subsequently served as assistant superintendent of the same shops and then as acting general superintendent of the 19th Grand Division until his appointment as general superintendent of the same division. Major Lester was formerly general foreman boiler maker on the Erie at Meadville, Pa., from April, 1906, to January, 1911, and was assistant master mechanic on the Baltimore & Ohio at Pittsburgh, Pa., until March, 1912, when he returned to the Erie as foreman boiler maker at Jersey City. From July, 1912, to July, 1914, he was assistant foreman in the tank shop of the American Locomotive Company at Dunkirk, and then was inspector with the Lima Locomotive Works at Lima, Ohio, and from February, 1915, to August, 1916, was boiler maker foreman on the Lehigh Valley at Sayre, Pa.

J. W. OPLINGER, superintendent of motive power of the Second and Third divisions of the Atlantic Coast Line, with headquarters at Waycross, Ga., resigned on May 1. He entered the service of the Central of New Jersey on March 1, 1874, as a machinist apprentice and after completing his apprenticeship in 1878, served as a machinist until 1880 on the same road. He then went to the Lehigh Valley as a machinist at Wilkes-Barre, Pa., and four years later left that road to go to the Atchison, Topeka & Santa Fe, in New Mexico, remaining in the service of that road until 1887. He then returned to the Central of New Jersey as gang foreman, and later was erecting foreman on that road. In 1894 he served as general foreman on the New York, Susquehanna & Western, and in 1900 was appointed master mechanic on the Atlantic Coast Line. Four years later he was promoted to superintendent of motive power of the Second and Third divisions, with office at Savannah, Ga., and since 1910 at Waycross, Ga., from which position he resigned to retire to his farm in Pennsylvania.

H. L. WORMAN, master mechanic of the St. Louis-San Francisco, with office at Memphis, Tenn., has been appointed assistant superintendent of motive power, with headquarters at Springfield, Mo.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

C. E. ALLEN, general master mechanic of the Northern Pacific, at Livingston, Mont., has been appointed general master mechanic of the lines east of Mandan, N. D., with headquarters at St. Paul, Minn., succeeding T. J. Cutler.

T. J. CUTLER, general master mechanic on the Northern Pacific, with headquarters at St. Paul, Minn., has been transferred to Livingston, Mont., with jurisdiction over the lines from Mandan, N. D., to Paradise, Mont., succeeding C. E. Allen.

G. R. Wilcox, assistant master mechanic of the St. Louis-San Francisco at Monett, Mo., has been appointed master mechanic of the Southern division, with headquarters at Memphis, Tenn., succeeding H. L. Worman. Mr. Willcox was born at Winfield, Kan., on September 10, 1879, and after graduating from high school attended the State Normal School at Stuttgart, Ark., for two years. In January, 1900, he entered railroad service as a machinist with the St. Louis Southwestern, and later worked in that capacity for the St. Louis, Iron Mountain & Southern at Bearring Cross, Ark., and for the Illinois Central at Memphis, Tenn. From the latter part of 1906 to the early part of 1907 he was division foreman of the St. Louis, Iron Mountain & Southern at Cotter, Ark., but in 1907 he came to the St. Louis-San Francisco as machinist and in September, 1908, was promoted to night roundhouse foreman. In July, 1909, he was appointed machine shop foreman, in 1911 general foreman and in July, 1913, was transferred to Birmingham, Ala., as general foreman. From February, 1914, to January, 1916, he acted as assistant foreman of the South roundhouse at Springfield, Mo., from January, 1916, to February, 1917, was general foreman at Ft. Scott, Kan., and from that time until April, 1919, he acted as assistant master mechanic at Neodesha, Kan., Sapulpa, Okla., and Monett, Mo. On the latter date he received his appointment as master mechanic of the Southern division, with headquarters at Memphis, Tenn.

SHOP AND ENGINEHOUSE

H. H. Maxfield, formerly superintendent of motive power of the New Jersey division of the Pennsylvania Railroad, with headquarters at New York, who was granted a furlough to enter military service, as an officer in the 9th Engineers, National Army, in July, 1917, has returned to the service of the Pennsylvania as acting works manager, with office at Altoona, Pa., in charge of the Altoona shops, comprising the Altoona machine shops, the Altoona car shops, the Juniata shops and the South Altoona foundries. This is a new position recently created on the Pennsylvania Railroad, Eastern Lines. Mr. Maxfield reports to the general superintendent of the Eastern Pennsylvania division and the superintendent of motive power of that division has been relieved of the jurisdiction over the above-named plants. While in France Mr. Maxfield was superintendent of motive power of the Transportation Corps, American Expeditionary Force.

PURCHASING AND STOREKEEPING

J. E. Anderson, purchasing agent of the Ft. Worth & Denver City; the Ft. Worth & Rio Grande; the Gulf, Colorado & Santa Fe.; the International & Great Northern; the Missouri, Kansas & Texas; the Missouri, Kansas & Texas of Texas, and the Texas Midland, with office at Dallas, Texas, has been appointed assistant purchasing agent of the St. Louis-San Francisco; the Kansas City, Clinton & Springfield; the Paris & Great Northern; the West Tulsa Belt, and the Rock Island-Frisco Terminal, with headquarters at St. Louis, Mo.

C. Z. Hughes has been appointed purchasing agent of the Ann Arbor Railroad, with office at Toledo, Ohio.

OBITUARY

Edward Lawless, master mechanic of the Illinois Central at Freeport, Ill., died at his home on March 9, at the age of 51. Mr. Lawless had been in the employ of the Illinois Central at Freeport since 1890, when he entered it as a machinist. He was promoted a number of times, and in October, 1917, was appointed master mechanic.

Supply Trade Notes

J. S. Cullinan has been elected president of the Galena Signal Oil Company, New York.

The Nathan Manufacturing Company, New York, has opened new offices in Chicago in the Great Northern building, 20 West Jackson boulevard, room 707, with R. Welsh in charge.

Joseph Douglas Gallagher, director, vice-president and general counsel of the American Brake Shoe & Foundry Company, New York, died at his home in Glen Ridge, N. J., on May 20, at the age of 65. He was educated at Princeton University and at Ohio Wesleyan University, Delaware, Ohio. He was engaged in the practice of law in Newark, entering the firm of Whitehead & Gallagher, which later became Gallagher & Richardson. Mr. Gallagher became director and vice-president of the American Brake Shoe & Foundry Company when it was organized about eighteen years ago, and during the last four years was also its general counsel. This company did much work on munitions for the United States Government during the war, and overwork in this connection probably hastened Mr. Gallagher's death, which followed an operation in the Morningside Hospital.

J. D. Gallagher

F. J. Foley, recently appointed general sales agent of the Railway Steel-Spring Company, New York, as was announced in these columns last month, was born in Chillicothe, Ohio, on May 14, 1879. He entered the service of the Baltimore & Ohio at Newark, Ohio, as a messenger in 1892, and then until 1897, was telegraph operator and despatcher on various roads in the West. He entered the manufacturing department of the Pullman Company at Pullman, Ill., in 1897, where he remained until 1900, when he became connected with the Steel Tired Wheel Company, which company was subsequently absorbed by the Railway Steel-Spring Company in 1902. Mr. Foley has been successively manager of all of its various spring plants, and while he has occupied the position of general superintendent of the company since 1912, during much of this time he was closely associated with the sales department.

F. J. Foley

George L. Fowler, consulting mechanical engineer, has moved his office from 83 Fulton street to 120 Liberty street, New York.

Ross F. Hayes has been appointed general sales manager of the Curtain Supply Company, Chicago. Mr. Hayes has been eastern manager of the company for 12 years, with headquarters at 50 Church street, New York, and will continue to act as eastern manager and retain his office in New York. Mr. Hayes was born at Lewiston, Me. He entered the service of the Boston Woven Hose & Rubber Company in 1888, remaining with that company for 16 years. He was a salesman in the rubber goods department in New England and New York state until 1893; and then served consecutively as city sales manager of the St. Louis branch for two years; New England representative of the bicycle tire department for two years; southern representative of the mechanical rubber goods department for two years, and as manager of the Philadelphia office until 1904. He then entered the service of the Curtain Supply Company, Chicago, as western representative, and since 1907 served as eastern manager of the company.

R. F. Hayes

Frank H. De Brun has been appointed mechanical engineer in charge of design and improvement for Mudge & Co., Chicago. Mr. De Brun was born in Switzerland in 1883 and received his education in the Higher Polytechnic University of Geneva. After graduation from that institution he served three years as an apprentice in mechanical and electrical laboratories in Switzerland and the following two years as a mechanical draftsman for the Coventry Motor Works, Ltd., at Coventry, England. The next seven years he was in the employ of the Royal Automobile Club of London, England, as superintendent in charge of garage and repairs, resigning from that position to come to the United States as manager of the Universal Auto Training School in New York City, where he remained for two years. In the fall of 1917 Mr. De Brun became associated with the Detroit Institute of Technology, where he had charge of the automotive engineering laboratories work, electrical equipment and battery work and special courses in the maintenance and repair of tractors.

F. H. De Brun

The Van Dorn Electric Tool Company, Cleveland, Ohio, has opened a Chicago office at 527 South Dearborn street, in charge of William Cottrell, sales manager.

The Joseph Dixon Crucible Company, of Jersey City, N. J., has moved its Philadelphia, Pa., sales office from 1020 Arch street to the Finance building, South Penn Square.

The Southern Railway Car Company has been organized at Wichita Falls, Texas, with James A. Jones, president, to make tank, railway and street cars; also to repair cars.

The Booth-Hall Company, designers and builders of electric furnaces, has removed its executive and sales offices from 2307-15 Archer avenue, Chicago, to the Hearst building, 326 West Madison street.

The Baldwin Locomotive Works has recently established a separate department for handling foreign sales in charge of F. de St. Phalle, recently elected vice-president, and Reeves K. Johnson is manager of foreign sales.

At the annual election by the board of directors of the Safety Car Heating & Lighting Company, New York, W. L. Conwell was made president of the company; J. A. Dixon, Randolph Parmly and James P. Soper, vice-presidents; C. W. Walton, secretary and treasurer, and William Stewart, assistant secretary and assistant treasurer. W. L. Conwell, president, has been connected with the company since January, 1916. He was born at Covington, Ky., on January 25, 1877. He received his education in the public schools of Philadelphia and at the University of Pennsylvania, from which he graduated in 1898 with the degree of electrical engineer. He then passed the examination for first assistant engineer for the United States Navy, but received no appointment because of the close of the war with Spain. He was employed in contracting work as a timekeeper for the Tennis Construction Company, Philadelphia, becoming later chief engineer and secretary of the company. In 1901 he resigned to become city salesman of the Westinghouse Electric & Manufacturing Company in New York. He was later placed in charge of the isolated plant department of the company, and for five years, ending in 1911, was engaged in railway work. In that year he became vice-president of the Transportation Utilities Company, and later became also treasurer of the same company. In January, 1916, he was appointed assistant to the president of the Safety Car Heating & Lighting Company, and upon the death of R. M. Dixon, former president of that company in October, 1918, Mr. Conwell was made acting president. His headquarters are in New York.

W. L. Conwell

The American Steam Conveyor Corporation, Chicago, has appointed N. B. Stewart district representative in charge of its St. Louis territory. Offices have been opened at 708 Merchants-LaClede building, St. Louis, Mo.

T. W. Holt, superintendent of shops of the Pressed Steel Car Company, Pittsburgh, Pa., who had entire charge of the munition work undertaken by that company, has resigned to become assistant general manager of the Curtain Supply Company, Chicago, succeeding the late R. S. Reynolds.

George W. Hoover, formerly in charge of the procurement of railway material in the Construction Division of the army, has been appointed manager of the St. Louis office of the Buda Company, Chicago, which office was opened on April 1 at 2025 Railway Exchange building.

The Clark Equipment Company, manufacturers of "Celfor" drills and precision tools, has just completed a modern hospital at its plant in Buchanan, Mich. The hospital is intended primarily for the use of employees, but is also open to citizens of the community at cost.

J. N. Ebling, recently returned from France, after spending 13 months with the American Expeditionary Forces, has resumed his position as president of the Railway Specialties Corporation, New York. D. A. Munro, formerly secretary, is no longer connected with the corporation.

The Duntley-Dayton Company, Chicago, has opened a branch office in the Century building, Cleveland, Ohio, under the management of J. C. Sague. This company has also opened a branch office in the Home Trust building, Pittsburgh, Pa., under the management of W. M. Hankey.

Frank H. Clark, formerly general superintendent of motive power of the Baltimore & Ohio, has opened offices at 15 Park Row, New York, and will undertake engineering investigations, report upon railway conditions and operations and prepare or co-operate in the preparation of plans and specifications for railway equipment and materials. He will also act in an advisory capacity to export firms and to foreign railway or other concerns purchasing equipment or material from manufacturers in the United States, and make such inspections as may be desired. Mr. Clark was associated for four years with David L. Barnes, consulting engineer, of Chicago, after which he entered the service of the Chicago, Burlington & Quincy, where he held successively the positions of chief draftsman, mechanical engineer, superintendent of motive power and general superintendent of motive power. He resigned his position with that company on December 30, 1910, to enter the service of the Baltimore & Ohio as general superintendent of motive power and held that position for eight years. He is a member of the American Society of Mechanical Engineers, the Franklin Institute and other technical societies. He is also a member of the American Railway Master Mechanics' Association and of the Master Car Builders' Association. He served as president of the M. M. Association for the early part of the term 1918-1919 and of the M. C. B. Association in 1910-1911.

F. H. Clark

The American Railway Equipment Company, Pittsburgh, Pa., on May 26, located its general offices in the Liberty building, Philadelphia, Pa., where G. W. Mingus, president of the company, will have his office. The company will retain an office in the Diamond Bank building, Pittsburgh, in charge of R. C. Crawford.

W. J. Cromie, who has of late years been with the Belmont Packing & Rubber Company, became associated with the Gustin-Bacon Manufacturing Company, 1021 Filbert street, Philadelphia, Pa., on May 1. Mr. Cromie was formerly connected with the B. & O. and the D. L. & W.

Lieut. Joseph P. Schneider, who for the past nine months has been on duty with the Railway Transportation Corps, U. S. A., as railway transportation officer with headquarters at Paris, France, has received his honorable release from the service and has resumed his duties as Western office assistant with the Locomotive Superheater Company at Chicago.

C. D. Barrett, who has just returned from France atter 18 months' service as an officer in the Transportation Corps of the American Expeditionary Force, has been appointed district engineer of the Locomotive Stoker Company, with headquarters at New York. He was born in Fort Wayne, Ind., and after graduation from Purdue University in 1901, he entered the service of the Pennsylvania Railroad as a special apprentice at Altoona. He remained with the Pennsylvania in the positions of motive power inspector, foreman, assistant master mechanic, assistant engineer of motive power and master mechanic until the summer of 1917. He then received a commission as major in the United States Army and went to France in command of the First Battalion of the Nineteenth Engineers. In France Major Barrett organized the St. Nazaire locomotive erecting shop, where all the locomotives used by the A. E. F. were erected. He remained in charge of this shop until July, 1918, when he was appointed assistant general superintendent of motive power in the Transportation Department.

C. D. Barrett

Oscar F. Ostby & Co., Inc., is the name of a new corporation recently organized, with Oscar F. Ostby as president. Mr. Ostby's offices, at 1044 Grand Central Terminal, New York, are the headquarters of the company, which will continue to handle the lines of railway supplies hitherto handled by Mr. Ostby, and in addition is the exclusive railway distributor for Davidson high speed steel and tools, manufactured by the Davidson Tool Manufacturing Corporation, New York. Mr. Ostby was born on March 5, 1883, and received his education in the public schools of Providence, R. I. From 1901 to November, 1904, he was engaged in publicity work, following which he was connected with the Commercial Acetylene Railway Light & Signal Company, serving as president of the International Acetylene Association during 1910-11. Later he was general manager of the Refrigerator, Heater & Ventilator Car Company. He has for some time represented the White American Locomotive Sander Company of Roanoke, Va., and since September, 1918, has served as vice-president of the

O. F. Ostby

Glazier Manufacturing Company of Rochester, N. Y. Mr. Ostby has been one of the leading members of the Railway Supply Manufacturers' Association and was its president in 1915-1916.

Stone Franklin Company

The Stone Franklin Company has been organized to market the Stone Franklin car lighting system in the United States and Canada. This system was introduced into this country by the Franklin Railway Supply Company. The new company has elected the following officers: Joel S. Coffin, chairman of the board of directors; Ralph G. Coburn, president; C. E. Walker, vice-president; H. D. Rohman, chief engineer, and W. Truelove, secretary, with offices at 18 East Forty-first street, New York.

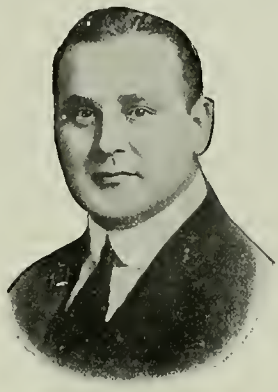
Ralph G. Coburn, president of the new company, has been identified with the Franklin Railway Supply Company. He was born at Boston in 1882, and graduated from Harvard in 1904. From 1904 to 1909 he was in the service of the American Glue Company, having charge of its western factories with his headquarters at Des Moines, Ia., and Chicago. On May 1, 1909, he opened the Chicago office of the Franklin Railway Supply Company as resident sales manager. On June 1, 1911, he was made assistant to the vice-president, in charge of eastern-southern territory, with headquarters at New York. In December, 1913, he was appointed eastern sales manager of the Franklin Railway Supply Company, which position he held until his appointment with the Stone Franklin Company.

R. G. Coburn

Charles E. Walker, vice-president of the new company, has had a broad experience in industrial manufacturing, sales and railroad work both in this country and abroad. He is a graduate of the engineering course of the University College, of Bristol, England. He served as an apprentice with the Bristol Railway Carriage Company and as junior assistant on the staff of the Newcastle Electric Supply Company. He later went to South America on the mechanical constructional staff of the Buenos Ayres & Pacific Railroad. While in South America he joined J. Stone & Co., Ltd., as technical adviser and sales manager with office in Buenos Ayres. In the latter part of 1912 he went to England to take charge of foreign sales in the main office at London. When war was declared he joined the British army and saw active service at the front for nearly three years. Receiving the order of the British Empire in February, 1917, he was returned to England to take charge of the manufacture of anti-submarine devices, which is the work he leaves to take up the position of vice-president of the Stone Franklin Company.

C. E. Walker

Harry D. Rohman, chief engineer of the Stone Franklin Company, New York, is a graduate of the technical schools of Zurich, Switzerland. Upon graduation he entered the works of the Oerlikon Electrical Construction Company, and in 1903 qualified as an electrical engineer, with experience in high and low tension and a. c. and d. c. work, especially electrical traction. Later he entered the service of J. Stone & Co., London, and in 1910 was appointed chief of the testing and experimental departments. In 1914 he was appointed chief assistant electrical engineer, and held that position until October 1, 1915, when he entered the service of the Franklin Railway Supply Company as chief electrical engineer, which position he held at the time of his recent appointment. Mr. Rohman speaks several languages and has had an extensive experience in all European countries, as well as in South Africa and the Belgian Congo. He has a broad experience in car lighting engineering, obtained by many years of active work in that field.



H. D. Rohman

E. Roy Bordon has been appointed service engineer of Mudge & Co., in which capacity he will have charge of investigating service given by the products manufactured by that firm and their successful handling, care and operation. He was born on January 17, 1893, at Galveston, Tex., and after graduation from the public schools entered Purdue University, Lafayette, Ind., where he remained for three years, at the end of which time he entered the service of the Pennsylvania at Fort Wayne, Ind., as a special apprentice in the shops of that road. The following year he returned to Purdue University, graduating from that institution as a mechanical engineer in June, 1915. In the fall of the same year he entered the employ of the Atchison, Topeka & Santa Fe in the test department where he remained until December, 1917, at which time he was commissioned a second lieutenant in the ordnance department of the United States army and sent to France. On February 13, 1919, he received his honorable release from the service and returned to the testing department of the Atchison, Topeka & Santa Fe, which position he held prior to his appointment with Mudge & Co. on May 1.

E. R. Borden

William K. Stamets, Pittsburgh, Pa., announces the opening of an office in Cleveland, Ohio, under management of William S. Dickson, formerly general manager of the Greaves Klusman Tool Company, Cincinnati, Ohio. The Stamets organization will represent exclusively most of machine tool manufacturers it now represents in Pittsburgh.

The Toledo Pipe Threading Machine Company, Toledo, Ohio, has organized a "Toledo Ten-Year Club," whose membership will be limited to owners of Toledo pipe threader machines that have been in service ten years. All applications for membership must be in by July 1, 1919, and on that date the six members owning the six oldest "Toledos" will be notified and given their choice of a Toledo ratchet threader complete or a Toledo, No. O, tool.

Colonel Douglas I. McKay has been elected president of the Pulverized Fuel Equipment Corporation, New York, to succeed John E. Muhlfeld, who has retired to return to consulting engineering practice. Since July, 1917, Colonel McKay has been engaged in war work. He was commissioned major in the Ordnance Department in charge of the raw materials branch of the gun division and purchased all raw and semi-finished materials used by the ordnance department and contractors for the ordnance department. Between August and December, 1917, these purchases amounted to $268,000,000. In January, 1918, he was promoted to lieutenant-colonel in the National Army and appointed assistant director of purchase and supply. Here he had supervision over the purchasing operations of the several supply corps of the War Department, including the ordnance department, the quartermaster department, the medical corps, the corps of engineers and the signal corps. He was subsequently promoted to colonel, and continued in this capacity until he returned to civil life after the armistice was signed. In addition to his duties as president of the Pulverized Fuel Equipment Corporation, Colonel McKay is also vice-president and director of the Chemical Foundation, Inc., director of the International Agriculture Corporation and director of the Botany Worsted Mills.

Col. D. I. McKay

Willis B. Clemmitt and George H. Ruppert have entered the employ of the Powdered Coal Engineering & Equipment Company of Chicago as advisory engineers. Mr. Clemmitt was formerly associated with the Central Iron & Steel Company at Harrisburg, Pa., and Mr. Ruppert, before his entry into the chemical branch of the government military service, had charge of the sodium-ferro-cyanide department of the Semet-Solvay Company.

The Wetmore Reamer Company is the new name of the Wetmore Mechanical Laboratory Company, of Milwaukee, Wis. This company has completed all of its contracts with various munition makers of Canada and this country to whom it supplied Wetmore expanding reamers, hobs, taps, lathe and boring bar tools. Since the completion of this work it has resumed its former tool business, specializing in a type of expanding reamer for all grades of industrial reaming operations. More floor space has been added and the offices enlarged. P. H. Door, recently released from the government service, is secretary and sales manager.

The Carborundum Company

Frank J. Tone has been elected president of the Carborundum Company, Niagara Falls, N. Y., in place of F. W. Haskell, deceased, and George W. Rayner has been elected vice-president. Mr. Tone was formerly works manager, having been in charge of manufacturing operations since the setablishment of the works at Niagara Falls in 1895. He was previously engaged in electric railway work in Pittsburgh. He is well known for his work in the electric furnace field on artificial abrasives, refractories and silicon alloys, and is past president of the American Electrochemical Society. Mr. Tone graduated from Cornell University in 1891.

F. J. Tone

George R. Rayner, the new vice-president of the Carborundum Company, was born in Springfield, Mass. He served for a period of time as a member of the sales force of the Hampden Wheel Company, and in June, 1898, he was appointed manager of the Chicago branch of the Carborundum Company. In August of the same year he was transferred to Niagara Falls, and was appointed secretary and general sales manager of the company. Mr. Rayner is a past president of the American Foundry & Supply Association and is a member of the board of directors of the Chamber of Commerce, at Niagara Falls.

G. R. Rayner

Railway Business Association

This association's committee on government purchasing policies was organized in New York City recently. The chairman of the committee is Knox Taylor, president of the Taylor-Wharton Iron & Steel Company, High Bridge, N. J.; and the other members are Samuel G. Allen, vice-chairman, Franklin Railway Supply Company, New York; G. S. Brown, president, Alpha Portland Cement Company, Easton, Pa.; Andrew Fletcher, president, American Locomotive Company, New York; Howard A. Gray, manager railroad sales, Joseph T. Ryerson & Son, Chicago; A. L. Humphrey, president, Union Switch & Signal Company, Swissvale, Pa.; A. H. Mulliken, president, Pettibone, Mulliken & Co., Chicago; L. G. Parker, assistant manager of sales Cleveland Frog & Crossing Company, Cleveland, Ohio; W. H. Woodin, president, American Car & Foundry Company, New York.

Colorado Brake Shoe and Foundry Company

The Colorado Brake Shoe & Foundry Company, Denver, Colo., was organized on January 1, 1919, by James C. Dolan, representative of a number of railway and mine equipment and supply firms at Denver, Colo. Mr. Dolan, in addition to assuming the presidency of the new company, retains his connection with the companies with whom he has been engaged for the past six years. Previous to this he was in the employ of the purchasing department of the Denver & Rio Grande for nine years.


J. C. Dolan

F. T. Dickinson, general manager of the new company was formerly superintendent of the Railway Material Company's plant at Toledo, Ohio, and later the plants at Phoenixville, Pa., and Stevens Point, Wis. Mr. Dickinson has been associated with the foundry business for the past 35 years, having received his early training in the general foundry business in Chicago. He first became interested in the manufacture of reinforced brake shoes while working for the Union Iron & Steel Company of Chicago in 1905. Soon after Mr. Dickinson was employed by the American Brake Shoe & Foundry Company, and here he was given opportunity to develop ideas on permanent iron molds for making brake shoes. After remaining with the American Brake Shoe & Foundry Company for two years he resigned to establish the Illinois Malleable Company, of Chicago, in the brake shoe business. In 1909 Mr. Dickinson resigned from this company to accept the superintendency of the Railway Material Company's plant at Toledo and later, while still in the employ of this company, started and operated its new plant at Phoenixville, and later at Stevens Point, retaining the latter position until his appointment as general manager of the Colorado Brake Shoe & Foundry Company. Mr. Dickinson is the inventor of numerous brake shoes and foundry devices pertaining to the manufacture of steel brake shoes.


F. T. Dickinson

The company has acquired a modern brake shoe foundry with a floor space of 150 ft. by 250 ft. and equipped with modern machinery. This foundry has a capacity of 50 tons a day, entirely of reinforced brake shoes.

As a war memorial to the more than 8,000 employees of the Westinghouse Electric & Manufacturing Company who have entered the service of the government in the war, the company has decided to establish four technical scholarships each year. Candidates will be limited to sons of employees of the Westinghouse Electric & Mfg. Company and its subsidiaries and to the younger employees of the company or its subsidiaries who have been in their service for a period of at least two years and who do not exceed the age of 23. The selection is to be determined by competitive examination, to be conducted annually by the company's educational department under direction of a committee composed of three vice-presidents of the company.

Vauclain Succeeds Johnson as Head of Baldwin Locomotive Works

Alba B. Johnson, president of the Baldwin Locomotive Works, has resigned from that position and has been succeeded by Samuel M. Vauclain, hitherto senior vice-president. Mr. Johnson, who had been contemplating the step for a considerable time, presented his resignation at a special meeting of the board of directors in Philadelphia, May 9. He will retain his extensive interests in the company and will remain a director. In connection with the resignation and the election of Mr. Vauclain as president, there were rumors of friction between different interests in the company, but the existence of such friction has been emphatically denied by Mr. Johnson and Mr. Vauclain alike.


A. B. Johnson

Following the meeting of the board of directors, Mr. Johnson issued a statement in which he explained that he had desired to withdraw from the presidency of the company in order to devote his time to his extensive personal and public interests and in which he expressed his wishes for the success of Mr. Vauclain.

Mr. Vauclain declined to issue any statement, but said in answer to a question that there would be no change in the policy of the company.


S. M. Vauclain

Mr. Johnson has been connected with the Baldwin Locomotive Works since 1877 and its president since 1911. He was born at Pittsburgh, Pa., February 8, 1858, and upon his graduation from the Central High School of Philadelphia entered the employ of Burnham, Parry, Williams & Co., as the present Baldwin Locomotive Works was then known, as a junior clerk in May, 1877. On the advice of John H. Converse he studied stenography and then for about 20 months was in the employ of William Sellers of the Edge-Moor Iron Works, Wilmington, Del. Upon returning to the Baldwin works he became secretary to Mr. Converse and served in that capacity for 33 years, gradually working up in the company and taking over Mr. Converse's work. In 1896 he was made a partner in the firm of Burnham, Williams & Co., as the firm had then become known, and was in charge, first of sales and later, on the withdrawal of George Burnham, Jr., of sales and finances. Upon the incorporation of the company under the name of the Baldwin Locomotive Works on July 1, 1909, he was elected vice-president and treasurer, becoming president on July 1, 1911.

In the period during which Mr. Johnson was president the company had what may truly be called a phenomenal growth, its gross sales having increased from a total of $29,000,000 in 1912, the first full year after he became the head of the company, to over $98,000,000 in the year ended December, 1918. The total undivided profits over the same period increased from $4,470,000 in 1912 to $5,752,000 in 1918, while in 1917 a total was reached of $8,306,000, excluding the return from the Standard Steel Works Company and the Southwark Foundry & Machine Company.

Mr. Johnson has extensive personal and public interests, and is one of the country's leaders in export trade. He is president of the Railway Business Association; a member of the National Foreign Trade Council, having acted as president of all the National Foreign Trade conventions with the exception of the one in Cincinnati last year, and is connected with other commercial and civic organizations.

Samuel M. Vauclain, the new president of the Baldwin Locomotive Works, has been connected with the company or its predecessors since 1883, and its senior vice-president since 1911. He entered the employ of the plant in 1883 as a foreman. In November, 1885, he was promoted to superintendent of equipment, and in 1886 was advanced to general superintendent. He became a member of the firm of Burnham, Williams & Co., in 1896, and in 1911 was elected a vice-president of the Baldwin Locomotive Works. It is through his work as manager of operations in the Baldwin Works that Mr. Vauclain is generally recognized as one of the leaders in shop management in the country.

Mr. Vauclain's greatest work, however, was during the war, not only in connection with the work of the Baldwin Locomotive Works in supplying locomotives for the allied armies overseas, but also in connection with the great shell making plant of the Eddystone Munitions Company at Eddystone, Pa. Mr. Vauclain was on a number of occasions called into consultation with various of the allied governments, and so well was his work regarded that he was made a chevalier of the Legion of Honor by the French government. At a banquet given in his honor at the Bellevue-Stratford Hotel in Philadelphia on May 17, he was presented by Benedict Crowell, assistant secretary of war, with the Distinguished Service Medal for the part he played in America's mobilization for war. In this connection he served with the Council of National Defense, first in an advisory capacity and later as chairman of the committee on ordnance and as chairman of the committee on cars. After the War Industries Board was organized he became chairman of that body's special committee on plants and munitions and was also the head of the committee of car and locomotive builders.

Carl H. Peterson, western representative of the Baldwin Locomotive Works, Philadelphia, Pa., and the Standard Steel Works Company, Philadelphia, with headquarters at Chicago, resigned on May 1, to become president of the Iron Mountain Company, Chicago, and vice-president of the Jackson-Park Machine Company, Chicago. Mr. Peterson will be succeeded by Arthur S. Globe, southwestern representative of the Baldwin Locomotive Works and the Standard Steel Works Company, with headquarters at St. Louis, who will have the title of manager of the Chicago office, the title of representative having been abolished. Paul G. Cheatham, assistant to the western representative, with headquarters at Chicago, will become manager of the St. Louis office.

General Miller Heads New Oil Company

General Charles Miller, of Franklin, Pa., has assumed the chairmanship of the board of directors of the Home Oil Refining Company of Texas. General Miller occupies a unique position in the history of American railroads. He was the first man to recognize the great importance of a scientific study of oil and lubrication problems in transportation, and he taught the railroads the best ways and means to efficient and economical use of lubricating oils. Prior to 1869 the railroads began using what was known as pure West Virginia oil (a mineral oil from 28 to 29 gravity with a cold test of 10 below zero and a fire test of 175).

General Charles Miller

In July, 1869, General Miller formed a partnership with three associates and began to manufacture an oil in all appearances like pure West Virginia oil and meeting the same tests. The product was, however, superior because of the addition of certain materials. The company made a specialty of supplying railways with cylinder, engine and freight car oils. General Miller studied the subject of railway lubrication in all its aspects. His company was the first to formulate a plan of furnishing railway oils under contracts guaranteeing the cost per thousand miles on locomotives and freight cars. It was the first to organize a department of lubrication experts, whose services were given to the railroads.

In 1878 the Galena Signal Oil Company was shipping 12,000 barrels per year, supplying about 15 per cent of the railroad mileage in the country. In 1918 its product was said to be standard upon approximately 98 per cent of the entire railway mileage of the United States and Canada, with a large export trade to France and South America. With the advent of electric railways the company developed special oils to meet their requirements, making contracts on the same basis which had proved so satisfactory to the steam railroads. Not only did the company furnish lubricants to the railways but also signal oil, long time burner oil, headlight oil and other illuminating oils.

General Miller severed his connection with the Galena Signal Oil Company some months ago because of differences of opinion as to policy. The Home Oil Refining Company which he heads as chairman of the board has large oil contracts covering a production of 7,500 barrels per day in the Ranger and Burkburnett (Texas) fields. It also holds leases on approximately 200,000 acres of oil lands exceptionally well located and now in process of development. The company owns a refinery at Yale, Okla., now operating at 2,500 barrels daily capacity. It is constructing a large refinery at Fort Worth which will be in operation in a few weeks. Nearly 600 men are now engaged in the construction work on the site of 165 acres located on the St. Louis-San Francisco Railway in the outskirts of Fort Worth. Recently the Home Oil Refining Company purchased a convenient site of 50 acres at Franklin, Pa., for the erection of a large plant for the production of railroad oil.

Railway Mechanical Engineer

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Investigate Reclamation Practices

During the last few years the railroads have carried on reclamation work more extensively than ever before. In some cases the difficulty of securing material made reclamation necessary, and this was the deciding factor, rather than the saving effected. Now that conditions are becoming more nearly normal some of the reclamation practices put into effect during the war should be investigated to see whether they are economical under present conditions. It is quite possible that in many cases the purchase of new material would be cheaper in the end. There is another phase of the problem brought up by the changes in the prices of material and in the rates of wages which is perhaps of even greater importance, namely, the advisability of adopting more extensive reclamation policies. The advance in the prices of some materials has been greater than the advance in labor costs. New tools and new methods have been introduced, and some work that was uneconomical under former conditions can now be carried on at a saving. The entire status of reclamation work has been changed and present practices must be carefully reconsidered if costly mistakes are to be avoided.

Grinding Twist Drills

The practice of grinding all twist drills on special grinding machines is quite general in railroad shops, and it might seem that any comments on the advantages of this method are superfluous. Observation in some small shops, however, indicates that grinding by hand on ordinary stand grinders is by no means obsolete. Even in shops equipped with drill grinders mechanics often grind drills by hand to avoid making a trip to the tool room to obtain a sharp drill. The desire to save time in this way is praiseworthy, but the object is seldom attained. Unless the drill is ground on a special machine one edge is invariably longer than the other, and as a result the drill uses more power than it would if properly ground, its capacity to stand up under high speeds and heavy feeds is reduced and it becomes dull more rapidly than if both edges did an equal amount of work. The influence of grinding on the endurance of drills was illustrated by comparative tests of drills used for forming telltale holes in staybolts. Drills of small sizes are considered easy to sharpen by hand, yet machine sharpened drills permitted much more rapid work and finished 80 per cent more holes before becoming dull.

Locomotive Front End Design

There is probably no other part of the modern locomotive which is designed on such an unscientific basis as the draft appliances. It is surprising but nevertheless true that no attempt has been made to establish general rules for proportioning nozzles and stacks since 1902, when a series of tests was conducted by the *American Engineer* with the co-operation of the Master Mechanics' Association. During recent years several roads have made tests to determine suitable front end proportions for certain classes of locomotives. These have added little to the general knowledge of front end design, but have emphasized the need for further information on the subject, as in practically every instance these tests were undertaken only after it had been found that front ends designed according to the usual practice would not give satisfactory results.

The large amount of power used to develop draft in a locomotive boiler is seldom realized. In a simple locomotive at ordinary running speeds the back pressure is often equal to one-fourth of the mean effective pressure, in which case the draft requires one-fourth as much power as is developed by the cylinders. In compound locomotives the loss is still greater. Even a slight reduction in back pressure will cause a considerable increase in the power developed by the locomotive. One recent test showed that by a change in the front end arrangement, the back pressure could be reduced six pounds and the power delivered by the locomotive increased 188 hp.

A general redesign of the draft appliances on many locomotives is very desirable. This work cannot be done until the best proportions for the front ends of large locomotives are definitely established. However, the comparatively low efficiency of circular nozzles as compared with nozzles of irregular form has been proved and economies that are well worth while can be obtained by applying the later form of tip to existing locomotives as a temporary expedient until the best arrangement of draft appliances for modern motive power is developed.

Condemning Limits for Steel Wheels

The relocation of the limit of wear groove for wrought steel wheels ½ in. from the inside of the rim instead of ¾ in. as at present was discussed in the report of the Committee on Car Wheels presented at the convention of the Mechanical Section of the American Railroad Association. The committee stated that other factors besides the strength of the wheel are involved and suggested that a circular of inquiry will be sent out covering these points. Elsewhere in this issue will be found an account of tests recently conducted to determine the strength of the flange on steel wheels with the treads turned to the proposed condemning limit. These tests indicate that wheels worn to within ¾ in. of the rim still have an ample factor of safety to resist lateral stresses.

The possibility of getting more mileage from rolled steel wheels is so important that it should be carefully considered. The committee mentions the maintenance of drawbar height, truck clearance and the effectiveness of brakes as factors that might prevent the change in the scrapping limit. Some slight alterations in the trucks would probably overcome these difficulties in most cases, and if it were feasible the change should prove economical as it would reduce the cost of wheel renewals throughout the life of the car. Even though all trucks cannot be changed to admit of wearing the wheels to smaller diameter, there seems no reason why roads that are able to use wheels until the rims are ¾ in. thick should not be allowed to do so.

Spontaneous Combustion in Coal Chutes

The destruction of several coaling stations by fires, due presumably to spontaneous combustion in the coal, recently led the Insurance and Fire Protection Section of the Railroad Administration to issue a warning regarding conditions in and about coal chutes. When such accidents occur they cause serious interruption to traffic and every precaution should be taken to guard against them. Spontaneous fires in coal have been carefully studied and while all the causes are not definitely known, certain conditions that increase the fire hazard have now been well established.

Coal which is freshly mined may absorb oxygen from the air and the more finely divided it is the greater the tendency to heat due to this action. Damp coal also heats more readily than dry coal. Wood, greasy waste, or other combustible matter, furnishes a starting point for fire and should be carefully removed before loading the coal into the chutes. Probably the majority of fires in coal chutes could be prevented by avoiding the accumulation of fine coal in the pockets for any considerable period. The screenings will settle to the bottom, particularly in large pockets, and if the chute is not completely emptied this lower strata may remain undisturbed long enough to absorb oxygen and finally become ignited. Coal chutes should be emptied regularly once a day to clean out the fine coal and if there are any pockets from which the coal will not flow by gravity, they should be shoveled out or remodeled to remove the chance for spontaneous combustion which otherwise will exist.

The Welder in Locomotive Repairs

The importance of having competent welders, particularly in the repair of locomotive boilers, was again emphasized at the recent convention of the Master Boiler Makers' Association. The boiler being, so to speak, the heart of the locomotive, any laxity in its construction or inspection is usually followed by disastrous results. One vital feature of boiler making and repairing is the practice now becoming quite extensive, of welding patches to the sheets when repairing cracked or otherwise defective parts of the boiler. There is no other form of repair work that may be so easily slighted through incompetent or careless workmanship and still pass the required inspection, only to fail at some critical moment in the operation of the locomotive. Many excellent papers are published from time to time in the technical journals, devoted to railroad questions and it is the duty of the men who have taken up welding to keep themselves fully informed concerning the methods and progress of the art of welding. Both the electric and the acetylene gas welding apparatus have been developed to a point where they require only careful and intelligent operation to secure satisfactory results. Anyone taking up this line of work may be assured of every assistance from the manufacturers of the welding outfits, as well as from their shop foremen and should not fail to take advantage of every channel of information available. The importance of careful welding in every repair made to a locomotive boiler cannot be too strongly impressed on those who are engaged in this work.

Labor and Scientific Research

One of the significant actions taken by the convention of the American Federation of Labor, recently held at Atlantic City, was the passing of a resolution defining the attitude of the organization toward scientific research in its relation to industrial progress. The resolution sets forth that a broad program of scientific and technical research is of major importance to the national welfare, should be fostered in every way by the Federal government and that the activities of the government itself in such research should be adequately and generously supported in order that the work may be strengthened and extended. In setting forth the reasons for this action the resolution states that the productivity of industry is greatly increased by the technical application of the results of research in the various sciences, as well as in engineering and agriculture, and that the increased productivity in industry resulting from such research is the most potent factor in the ever-increasing struggle of the workers to raise their standards of living. One of the most significant reasons given for the action taken is that the importance of such productivity must steadily increase, since there is a limit beyond which the average standards of living of the whole population cannot progress by the usual methods of readjustment, which limit can only be raised by research and the utilization of the results of research in industry. The recognition of this situation by the great national labor organization is a sign of a most hopeful condition in the possibility for a better understanding between the various agencies which make up the national industrial structure. It is a platform on which the investor and the manager, as well as the worker, have every reason to take a common stand. Much excellent work has been done by the various bureaus of the federal government which has been of great practical value, and with proper support in the way of adequate appropriations the practical value of this work could be greatly increased.

Co-operation with Other Departments

In an organization as complex as a large railroad system the proper inter-relation of the departments presents a difficult problem. With each man engrossed in his own work and carrying out the plan of his immediate superior, conflicts of authority with consequent friction and bad feeling are almost sure to occur. If, as is often the case, all business matters are handled by mail or by wire and personal contact is eliminated minor irritations sometimes produce an effect out of all proportion to their actual importance and animosity is created between the different parts of the organization that has a very harmful effect on the morale. How often the roundhouse force vilifies the back shop force, which it has never seen, or the yard employees, with whom daily battles are fought over the telephone.

No base ball team could be successful if the first baseman refused to catch the balls which the short stop threw to him and no railroad can have a high record for efficiency unless there is teamwork among the different departments. If the roundhouse foreman and the yardmaster met occasionally when there were no differences to be decided between them, the acquaintance would no doubt lead to better relations during working hours, with the result that Bill would take more interest in telling Jim what trains he expected to run and Jim would try to have the power ready in time to meet Bill's schedule. System is a wonderful thing, but some of our railroads are overburdened with it. A few hours a week devoted to common human intercourse between members of different departments is the best lubricant for any organization and one that is often sorely needed.

Retrenchment and Maintenance

The Railroad Administration has recently inaugurated a policy of retrenchment in an effort to reduce the large deficit that is being incurred. Much criticism has been directed at the railroad companies in the past because of the methods adopted when reductions in expenses seemed necessary, due to financial and traffic conditions. Beyond a doubt much of this criticism has been merited. The serious objection to any drastic retrenchment policy is that it attempts to control expenses without regard for the natural factors that influence costs and, therefore, often leads to the adoption of measures which in the end prove false economies.

Reductions in unit costs are often demanded when there is a decrease in traffic, but this is contrary to the natural tendency of unit costs to increase as the business decreases. Heavy loading of cars and locomotives is essential for economy of operation, but where there is a reduced traffic to move, it is almost impossible to haul the maximum average tonnage per train. Thus the cost of fuel and of wages for train and enginemen have a tendency to increase in proportion to the amount of traffic handled. The possibilities for economy in this direction are small and any saving must be effected almost entirely in the cost of maintenance of way and repairs to locomotives and cars. While the *total* expense for equipment maintenance will fall as the traffic declines, the *unit* expense has a tendency to increase, and an immediate substantial reduction in the unit costs can be secured in only one way, by slighting the work.

During the war equipment was not maintained to a high standard. There has been a marked improvement in the last few months, but it would be a serious mistake if the roads, in an attempt to make a show of economy, should again neglect the little things that are so important in railroad operation. The ultimate economy of a high standard of maintenance cannot be questioned and if the officers of the mechanical department could impress on their superiors the many ways in which the elimination of small items leads to much larger expenses, some of the drastic reductions in maintenance allowances might be avoided. The neglect of minor repairs causes equipment to deteriorate rapidly. Lack of attention to draft appliances, flues, fireboxes and grates results in inefficient combustion. Valves out of square, packing blowing, or auxiliaries in poor condition cause a waste of steam. These factors contribute to delays on the road and increase the expense of wages for train crews. Poor maintenance inevitably leads to waste and inefficiency. The Railroad Administration has indicated that an effort will be made to bring about a marked reduction in the cost of equipment maintenance. So far as this campaign is confined to developing improved methods, it deserves, and will surely receive, hearty support. It is to be hoped, however, that the administration officers will not resort to the short sighted policies that have been used under similar circumstances in the past to effect a reduction in expenses.

NEW BOOKS

Cambria Steel Handbook. Prepared and compiled by George E. Thackray, C.E. 603 pages, illustrated, 4½ in. by 6¾ in., flexible binding. Published by the Cambria Steel Company, Philadelphia, Pa.

This is the twelfth edition of the Cambria handbook and in addition to a thorough revision of all data pertaining to the various structural steel sections manufactured by the Cambria Steel Company, it contains a large amount of new material covering the wider range of structural steel sections now manufactured, and includes additional tables of use in calculations involved in the design of structures in which the sections are used. Among the new sections for which illustrations and properties are included in the new edition are a number of bulb angles, small channels for cars, ship channels, T-bars and three sizes of rolled steel car stakes. Among the large number of new tables which have been added are weights of flat and corrugated steel sheathing, roof truss dimensions and stresses, sizes of spikes and wood screws, square roots and cube roots of fractions, weights of circular steel plates, trigonometric formulae, etc.

Applied Mechanics, Volume II, Strength of Materials. By Charles E. Fuller, S. B., and William A. Johnson, S. B., professors of theoretical and applied mechanics, Massachusetts Institute of Technology. 556 pages, 6 in. by 9¼ in., illustrated, bound in cloth. Published by John Wiley & Sons, Inc. New York.

While this book has been prepared primarily for the students of engineering in the Massachusetts Institute of Technology, it covers the fundamentals of applied mechanics to such an extent that it will be found a valuable text book for any engineer's library. A person using this book should have a fundamental knowledge of differential and integral calculus, the principles of statics and dynamics and the methods of determining centers of gravity and moments of inertia of areas and solids. The subject has been developed logically, special care being taken to point out the limitations of the different theories, and emphasis is laid on the divergence of the conditions met in practice from ideal conditions. Graphic methods of solution have been freely employed and a number of problems involving the application of each of the theories discussed have been included and solutions given where it has appeared that these would be an aid to a clear understanding of the subject. The authors of the book have had many years' experience in teaching the subject, and this book is the result of their most careful study of the manner in which such an important subject can be more clearly and firmly fixed in the mind of the student. It covers the physical properties of materials, a study of stress and strain with their application to beams of various loading, and a discussion of the general theory of flexure, columns, shafting and springs, curved bars, arches and catenaries, cylinders and plates, and reinforced concrete beams and columns.

COMMUNICATIONS

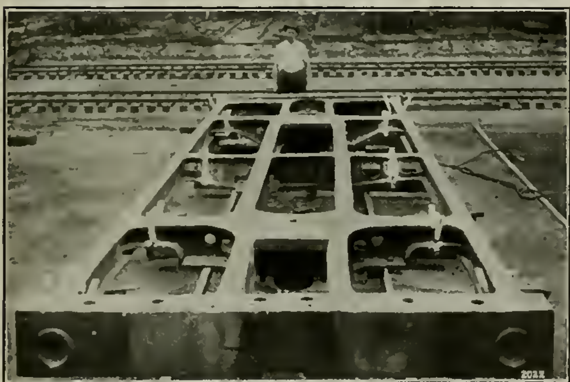
THERMIT VS. AUTOGENOUS WELDING

Clifton Forge, Va.

To the Editor:

I have read with a great deal of interest the article "Oxy-Acetylene Welding Problems," by Mr. W. L. Bean, in the February issue of the *Railway Mechanical Engineer*, and was particularly interested in the description given by him of reclaiming a damaged Commonwealth cast steel one-piece tender frame. We had an occasion to make repairs to a frame similar to this one, but used the Thermit process of uniting the members of the frame after they had been cut apart for straightening instead of using oxy-acetylene or electric processes, both of which we have in use at these shops.

The frame shown in the illustration was 28 ft. long and 9 ft. 6 in. wide, the members being of heavy I-beam sections; the weight was approximately 15,000 lb. The frame was very badly bent and in order to straighten it we found it necessary to cut the side sills. These sills were then straightened in a pneumatic press after being heated in a large furnace. The rest of the frame was then heated by the use of a blow torch and straightened, after which the side sills were clamped into position and welded with Thermit, making ten welds in all.



Cast Steel Tender Frame Reassembled by Thermit Welding Process

In making the welds 1,150 lb. of thermit was consumed. I should like to call your attention to the following comparative results as shown by the two operations, which indicate an advantage in time, cost and strength of weld by the method we used over the New Haven method:

Time—The method used by the New Haven consumed about six weeks. The time consumed in preparing the frame and welding it at the shops at this point was only 10 days.

Cost—The cost of reclaiming the frame on the New Haven was about the same as a new frame. The cost of reclaiming the frame with the Thermit process was $502.50. A new frame would have cost approximately $1,500.

Strength of Weld—The Thermit weld leaves no doubt as to the strength of the weld, owing to the thorough amalgamation of the metal due to the intense heat of the Thermit reaction. After 15 years' continuous use of the Thermit process of welding at the Clifton Forge shops we have found it to give us the best results. Especially is this true where heavy sections are to be welded.

Since November, 1908, we have made approximately 300 frame welds, and it is very gratifying to say that only six failures have occurred. The welded tender frame has been in continuous service for upwards of two years.

E. A. Murray, Master Mechanic.

INADEQUATE MAIN BOXES

Allston, Mass.

To the Editor:

The communication on inadequate main boxes from Charles F. Prescott, which appeared in the April, 1919, issue, has awakened many thoughts in the minds of persons who are interested in this subject. The wear of main driving boxes on heavy locomotives is one of the chief factors causing engines to be shopped with a small amount of mileage; that is, the main box does not give service in proportion to the other parts of the engine, and distributes the effect of its poor condition to the other parts.

This necessitates the treatment of main driving boxes at short intervals, or an engine going to the shop on small mileage, because of the wear and tear due to the bad condition of the main driving boxes. To all who are familiar with this condition, the problem is how to avoid it without the introduction of something which will require more expert attention. One of the most important features of the locomotives designed in the United States is simplicity of construction and the abuse they will stand when maintenance is neglected.

The solid crown brass is a development away from the three-piece crown brass with a wedge center. The solid key in the eccentric is a development away from the rifled key and set screw which gave us the slipping eccentrics.

Mr. Prescott says that the lengthening of bearings toward the neutral axis of the axle has not resulted in improvement. My opinion is that the reason we have found no improvement in extending the bearing toward the neutral axis is that we have not made a scientific distribution of the work on the bearing surface; that we have not made any provision for compensation of the difference in the coefficient of expansion of the various metals massed together between the frames.

The bearing surface of the crown should be bored out between the ends of the brass, allowing a bearing surface on each end to prevent the escape of grease, so as to bring the bearing down on the sides where the piston thrust is concentrated. The bearing on the shoe and wedge should be cut away for about one-third of the width of the shoe and wedge face on each side so as to concentrate the lead from the thrust of the piston in the center of the points of bearing between both ends. For example, assume that the width of wedge and shoe faces were 15 in.; after having fitted them up for the box the next operation would be to set them up on the planer and, starting on lines 2½ in. each side of the center, plane the faces to allow 1/64 in. clearance at the edges. This will permit the box to align itself to the journal bearing.

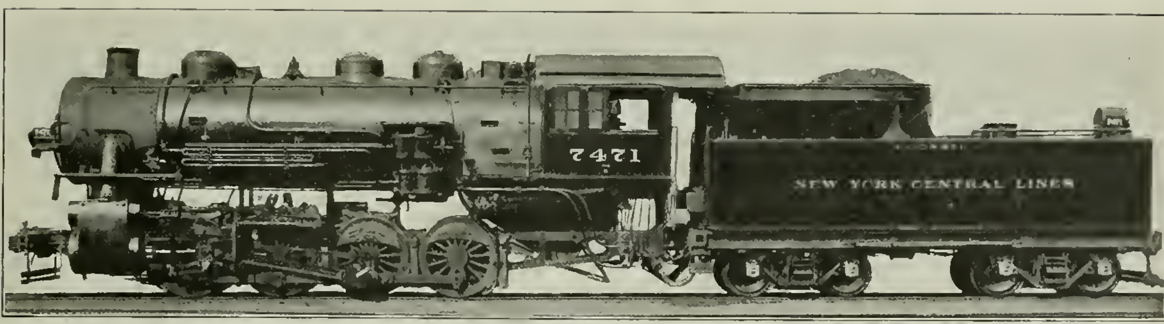
As driving boxes are now fitted, the ends of the bearing wear and cause pounding because the shoe and wedge hold the box so that it cannot adjust itself to the axle alignment.

To compensate for the coefficient of expansion I would suggest a spring under the wedge which will balance the weight of the wedge and also compensate for inertia when the engine is riding, with provision made for the wedge to unload itself by backing down when loaded by virtue of the expansion. This is not to be construed to mean a wedge with a constant spring thrust to maintain adjustment for wear.

The ¾ in. per ft. taper used in the wedge may be proved mathematically as about equal to the coefficient of friction between the wedge and bearing on the frame so that zero may be taken as the amount of work necessary to hold the wedge up against the piston thrust.

Frequently the brasses are loose at points in the box and this is caused by the inequality of expansion of the different metals, the consequent compression being exerted on the metal offering the least resistance.

John C. Murdock.



Eight wheel Switcher Converted from Consolidation Type Locomotive

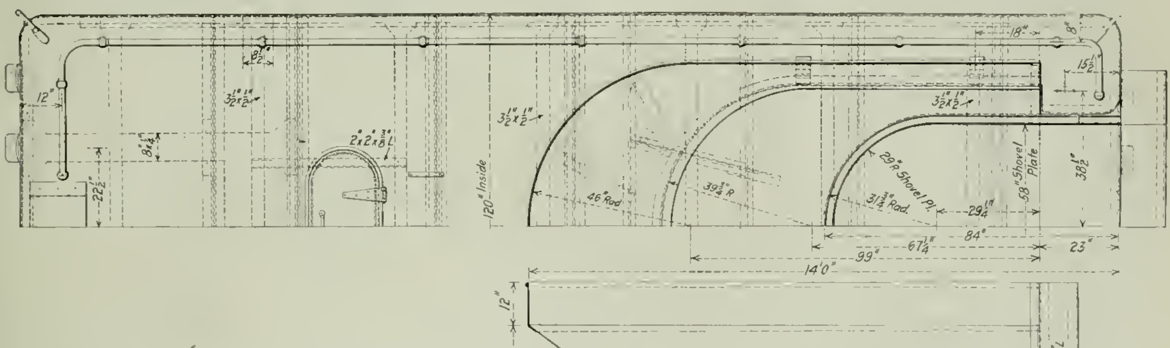
C. C. C. & St. L. 0-8-0 Switchers

Consolidation Type Converted with Special Features to Adapt Engines for Switching Service

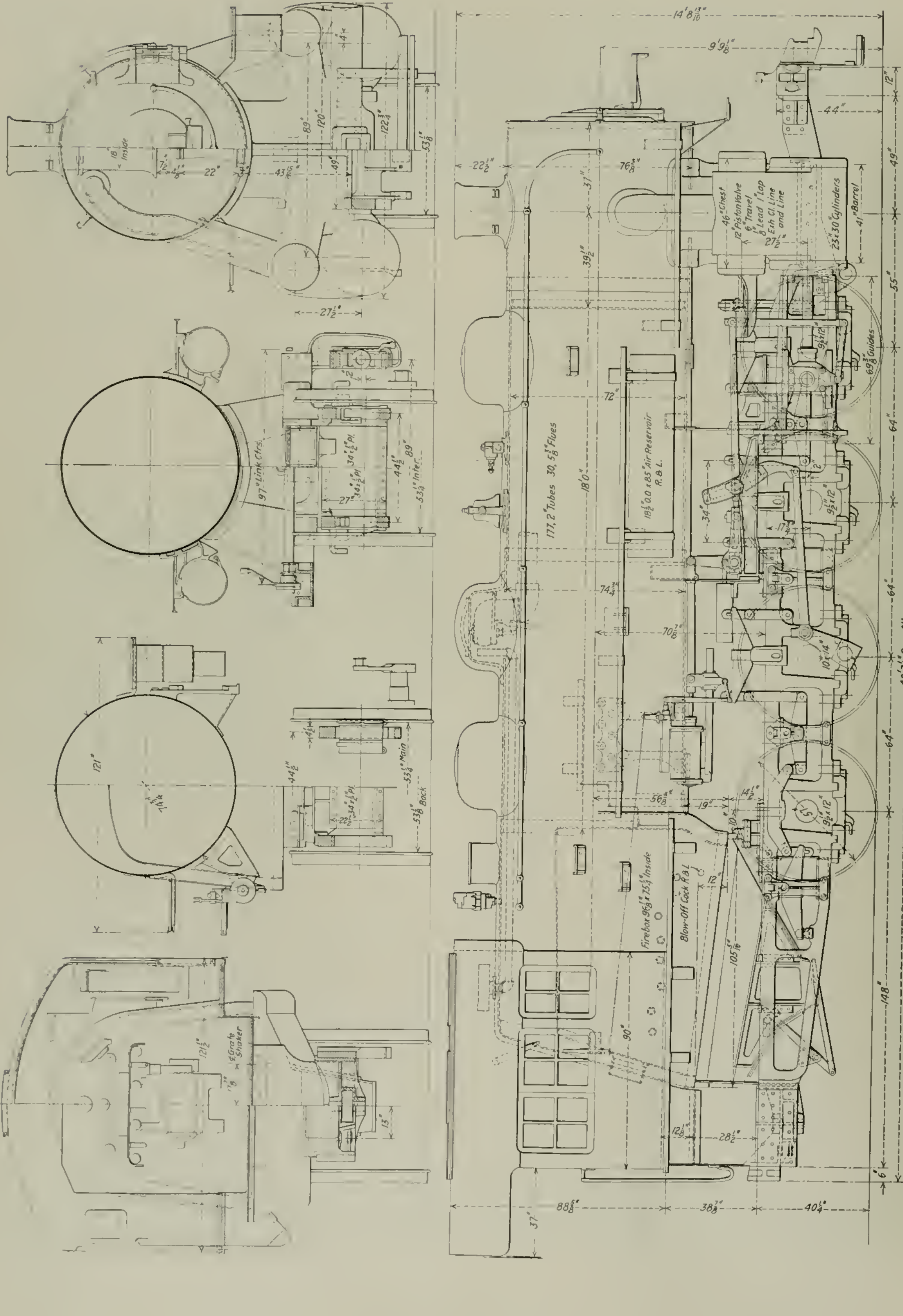
BY R. W. RETTERER
Assistant Mechanical Engineer, C. C. C. & St. L.

The constantly growing demand for increased locomotive capacity due to the heavy freight traffic and the increase in train loads has necessitated heavier and more powerful switching locomotives to handle efficiently the heavy trains brought into the terminal yards. A switching locomotive in order to meet these demands must necessarily be equal, at least, in tractive effort to the heaviest road locomotive, and must also be of such design as to insure quick operation. To accomplish this the Beech Grove shops of the Cleveland, Cincinnati, Chicago & St. Louis have completed the first of 15 eight-wheel type switching locomotives in which a number of interesting features have been incorporated.

As the prices of material entering into the construction of locomotives were much above normal, it was found a considerable saving could be made by converting Consolidation type locomotives into 0-8-0 switchers. The Consolidation locomotives selected were built in 1900, having a tractive effort of 43,000 lb., 22-in. by 30-in. cylinders, and 57-in. driving wheels. Conditions had shown that these locomotives were not sufficiently powerful to handle a train of satisfactory tonnage at scheduled speeds in freight service. In designing the new locomotive it was imperative that, to keep down operating costs, every hour of high priced labor should be made to produce the utmost. With this result in view, the



Design of Tender Tank Which Delivers 75 Per Cent of the Coal at the Coal Gates



Side Elevation and Sections of Big Four Eight-wheel Switcher design of each item that makes for economy of operation was carefully gone over, considering not only the railroad company's interest but also the convenience for the shop and enginemen.

The elimination of the front truck with the consequent increase in weight on driving wheels made it necessary to provide larger cylinders, 23-in. by 30-in. cylinders of the outside steam pipe design being applied. The relation of boiler capacity to the cylinder demand, calculated in accordance

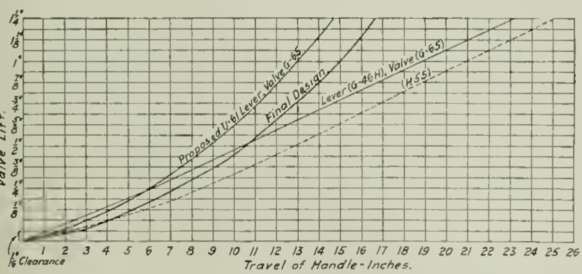


Fig. 1—Diagram Showing Relation Between Valve Lift and Travel of Handle for Various Types of Throttle Rigging

with Cole's ratios, shows ample boiler capacity both as to heating surface and grate area. The boiler is of the radial stay, straight top, wide firebox type having 177 2-in. tubes and 30 5⅜-in. flues. The Locomotive Superheater Company's type A superheater and the American brick arch are used. The total heating surface is 2,621 sq. ft. and the superheating surface 551 sq. ft., with a grate area of 50.2 sq. ft. The boiler is fitted with a one piece pressed steel dome.

The smokebox design is generally similar to that of a Mikado locomotive. The front end is mounted on the smokebox by a hinge of cast steel, amply strong to permit swinging the boiler front to one side, permitting easy access to the superheater units and other front end parts without the entire removal of the boiler front. The hinge is fitted with an eccentric cam which when turned, pushes the front end off the studs, allowing it to swing to one side. This feature eliminates the necessity of using several men when the smokebox front must be removed in the roundhouse.

Steam is supplied to the cylinders through a 7½-in. dry pipe and 7-in. branch pipes, the admission being controlled by a balanced throttle valve. The throttle rigging is of a different design than is ordinarily used. The curve shown in the throttle rigging drawing indicates the lift of the valve plotted against the movement of the throttle lever for these locomotives and for other classes having different throttle rigging. This action gives an easy opening throttle on the start, and also provides for a quick acting engine. The rigging is adjustable to permit taking up the wear, as will be noted from the general arrangement shown in Fig. 2. The Walschaert valve gear and the Ragonnet power reverse gear are used, the controlling levers being conveniently located in the cab.

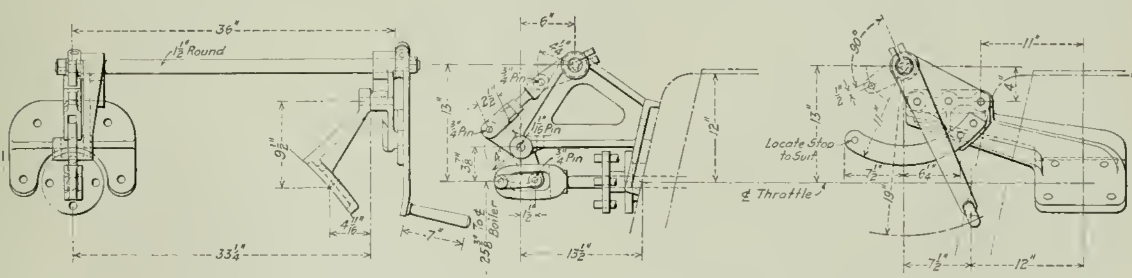
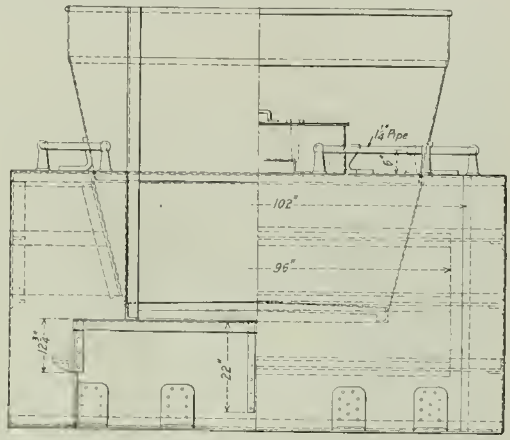


Fig. 2—Arrangement of Throttle Lever Used on Big Four Switchers

Each frame is a single steel casting 37 ft. 0 in. long. The top rail is 4½ in. wide by 5¾ in. deep, the section changing to 4½ in. wide by 6¾ in. deep over the jaws, the lower rail being 4 in. deep. The single rail to which the cylinders are bolted is 4½ in. wide by 10 in. deep. The frames are securely tied between each pair of drivers with a cast steel cross brace. The brake rigging is designed so as to eliminate the large holes through the frame for the brake hanger pins. The brake hanger supports are bolted to the frame and a short pin is used for supporting the hanger. This feature has done away with the annoying hanger pin failures where the pin is fitted into the frame. A combination brake fulcrum and cross equalizer support is used which permits using a short shaft for the brake fulcrum in place of the usual shaft



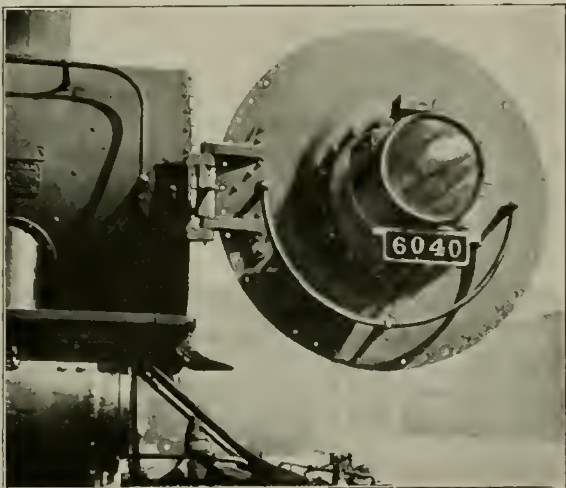
Half End Elevations of the Big Four Switch Engine Tenders

which extends from frame to frame. This permits the removal of one fulcrum independently of the other, also where the clearances are small as is usually the case, the short shaft can be readily removed.

In designing the spring rigging the center of gravity of frames, cross ties, cylinders, etc.,—that is, all parts above the springs except the boiler and attachments,—was calculated as one factor, and of the boiler and attachments as another factor. The boiler was then located so as to make the center of gravity of the whole slightly to the rear of the center line of the wheel base. From these data, the load on each spring was calculated, and the equalizers between drivers were designed so as to be in balance with the load applied. The results of this method are shown in the scale weights of the first engine out of shop, the additional weight on the main wheel being largely due to the weight of heavier rods, counterbalances and valve gear parts connected to it. The weight on each pair of drivers is as follows:

Front wheels	Intermediate wheels	Main wheels	Rear wheels	Total
54,100 lb.	53,200 lb.	57,800 lb.	54,900 lb.	220,000 lb.

The question of making available at the coal gate of the tender a greater per cent of the coal carried without shoveling down by the fireman or taking coal at frequent intervals has become more a matter of importance as the size of engines and trains has increased. To obviate the necessity for coal pushers an investigation was conducted which resulted in the final design of a tender tank with a conical space for coal, the capacity being 9,000 gal. of water and 12 tons of coal. Actual service results show that the coal works forward to the fireman without shoveling down. Some of the features of the design are as follows: Practically all coal is available to the fireman; 75 per cent without opening the gates. The tender carries the same amount of coal as other designs with additional water space of approximately 1,000 gal. The rusting of slope sheets due to the collection of old coal is eliminated. An engine can be coaled with but one spotting under the dock. The self feeding of coal and the increased



Smokebox Front Mounted on Hinge to Permit of Easy Access to the Front End

water capacity eliminate water and coal stops and there is no bad coal left as an accumulation in the tank.

The following table gives the principal dimensions and ratios of these locomotives:

General Data	
Gage	4 ft. 8½ in.
Service	Switching
Fuel	Bit. coal
Tractive effort	47,200 lb.
Weight in working order	220,000 lb.
Weight of engine and tender in working order	380,000 lb.
Wheel base, driving	16 ft. 0 in.
Wheel base, engine and tender	54 ft. 3 in.
Ratios	
Weight on drivers ÷ tractive effort	4.66
Tractive effort × diam. drivers ÷ equivalent heating surface*	780.5
Equivalent heating surface* ÷ grate area	68.7
Firebox heating surface ÷ equivalent heating surface,* per cent	5.6
Weight on drivers ÷ equivalent heating surface*	63.8
Volume both cylinders	14.42 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	239.0
Grate area ÷ vol. cylinders	3.48
Cylinders	
Kind	Simple
Diameter and stroke	23 in. by 30 in.
Valves	
Kind	Piston
Diameter	12 in.
Greatest travel	6 in.
Outside lap	1 in.
Wheels	
Driving diameter over tires	57 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	10 in. by 14 in.
Driving journals, others, diameter and length	9½ in. by 12 in.
Boiler	
Style	Straight top, wide firebox
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	74¾ in.
Firebox, length and width	96⅛ in. by 75¼ in.
Firebox plates, thickness	½ in.
Firebox, water space	4½ in.
Tubes, number and outside diameter	177—2 in.
Flues, number and outside diameter	30—5⅜ in.
Tubes and flues, length	18 ft. 0 in.
Heating surface, tubes and flues	2,428 sq. ft.
Heating surface, firebox and arch tubes	193 sq. ft.
Heating surface, total	2,621 sq. ft.
Superheater heating surface	551 sq. ft.
Equivalent heating surface*	3,447 sq. ft.
Grate area	502 sq. ft.
Tender	
Tank	Water bottom, conical hopper
Weight	160,000 lb.
Wheels, diameter	36 in.
Journals, diameter and length	5½ in. by 10 in.
Water capacity	9,000 gal.
Coal capacity	12 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

A LOCOMOTIVE REPAIR SHOP OUTPUT SCHEDULE

BY H. L. BURRHUS

Is it possible to rate locomotive repairs on a manufacturing basis and figure output at a regular stated amount per month? In the past the answer to this question has been that the nature of repairs varies so much that it is impossible to place any specified shop time on a locomotive when it receives general repairs.

There was a time when one shop would claim to handle 40 locomotives a month while some other shop could only boast of 30, yet the shop which turned out the 30 locomotives actually did more work, for they counted only such engines as received a general overhauling as an engine out of shop, while the shop which claimed the 40 engines as a month's output would charge every class of repairs as "general." Now that all shops are using the same unit of measure to classify repairs we can compare the output of shops with greater accuracy. As all shops are paying their workmen on a day work basis, conditions are even more comparable, and any wide variance found in shop output must be due to the shop system or facilities.

Man effort is the same in the east as in the west, hence the shop equipment and system are the deciding factors in the maintenance or the building up of shop output. If several shops have different scheduling systems, the reason why one shop exceeds in output is that their system is better in preventing loss of time and waste of man power.

There are many shop scheduling systems in use which are giving good results, but as a rule they require the services of several clerks and considerable book or card keeping. A system which can be handled by the foremen without adding to their already numerous duties would be desirable, and as we look to the initiative and judgment of the supervising forces to carry out any system, we should not burden a foreman with additional clerical duties.

As cost of repairs, shop time and working schedules are all based on hourly time, it is practicable to develop an "hourly period system."

Before going into the details of this proposed system, let us see how the "shop schedule system" compares with the "hourly period system." If the shop schedule system has been developed on the basis of a ten-hour day and the shop working period is reduced to eight hours a day, the system is entirely disorganized, and if some unlooked for holiday is granted, the schedule is upset. The hourly system period, being based on the one-hour period, is flexible and covers these conditions irrespective of the number of hours worked each day.

It may be claimed that a shop schedule system is not based on the time taken to complete operations, but to see that operations are completed in a specified order so that work in the erecting department will follow in proper sequence. Such a system is at fault in that there may be many lapses of time between the delivery of finished parts, hence any workable shop schedule is a time system, irrespective of the system adopted and the elimination of a vast amount of detail is provided for when a final date is given for an engine to leave the shop. If an engine is marked up to go out of the shop on the fifteenth of the month, that one date is the summary of every item of detail which the various departments should provide for.

With the hourly period system, if the class of repairs requires 120 shop hours and every foreman knows the number of hours he is allowed for his portion of the job, he needs no card record or follow up system to see that his particular part is delivered on time.

Shop conditions naturally affect the number of working hours required to overhaul an engine. In a shop where the stripping is handled by a special stripping gang we find it is possible for 15 men to strip an engine in one 10-hour day or 150 work hours. If, as often happens, this gang is short a few men there should be no failure to complete the stripping on time as the number of man hours necessary to strip an engine is known to be 150 hours whether it be 15 men working 10 hours or 10 men working 15 hours. It is easy to lose sight of time when an engine first comes in the shop but this is the critical period and the time to rush repairs is at first—not the last few days.

When the shop is placed on an eight-hour working day we find that the original gang of 15 men makes a total of 120 effort hours a day, or 30 hours less than the required time, thus reducing the output of this gang to one engine less every five days.

To establish such a system we must depend on the experience and support of the foremen. To say that a foreman has no idea of the time required by his department to complete certain operations, is to admit that the selection of such a supervising officer has been at fault.

The foreman of a shop handling driving wheels had no system to get out his work and he usually started the heaviest jobs first, for he prided himself on turning out heavy jobs in a short time. He would turn tires and take care of crank pins first and in the meantime the boring and facing of the driving boxes would be held up.

A time schedule of 40 hours was placed on this work as follows: 15 hours from the end of stripping time to the completion of journal truing; 20 hours to completion of crank pins and 40 hours from the end of stripping time to the time the completed set of driving wheels was delivered to the erecting gang. This arrangement allowed for driving boxes being bored and faced so that at the end of 40 hours after stripping they also were delivered to the erecting gang. The foremen soon learned to watch the stripping pit to see what they would have to do on their particular parts of the work. As the wheels were dropped shortly after stripping began, the driving box foreman could note if any new boxes were required and it was not unusual to have new boxes brought in from the storehouse and machine work started by noon on the day an engine was being stripped. By nine o'clock the wheel foreman had checked the crank pins so that orders for material were placed fully eight hours before his working time period began.

The hourly period system required a set of driving wheels to be delivered ready for application in 40 hours. The foreman of the wheel department could meet this demand by working his entire force on one set of wheels but in the meantime, the stripping gang had delivered another set of wheels which was also due to leave the department in 40 hours.

The wheel shop was tied up tight and the hourly system period showed up the faults at once as it was found that this foreman did not keep his men regularly on one job. A mechanic would start to turn journals, then go to the tire lathe and then perhaps turn a new axle, but by assigning men to regular jobs and planning to keep the work coming to them in stated quantities it was soon found that wheels could be delivered to meet the requirements.

After checking up the driving box work and placing 40 hours as the time limit to complete a set of boxes it was found that certain conditions in this department delayed the work. Because of a rough floor two men were required to a truck instead of one and the extra man did not have steady work. This condition was corrected. Depending on the busy overhead electric crane caused many delays, so an individual crane was installed. The arrangement for pressing out and pressing in brasses was very unhandy and at a slight expense a press was installed so that these time delays were eliminated. These and many other things, unnoticed before, were brought out when the foreman was required to deliver a set of finished boxes 40 hours after he received them.

Ask any erecting foreman how long it will take him to put out an engine and he will tell you so many hours after he receives the wheels and boxes and other fittings and he needs no card system to follow up his work. Keep him supplied with finished work from the various shops and he will keep his date—or as is often the case—reduce the time an hour or two.

When the engine has been delivered to the erecting pit, parts such as spring rigging, shoes and wedges and other parts handled by the erecting gang are also delivered at the same time and we now start on our hourly period system to handle these parts. Spring rigging has been scheduled for a 50-hour period, subdivided as follows: Five hours, after completion of stripping, to be inspected and parts delivered to various departments for attention; 15 hours from the end of this period all forging and blacksmith work to be completed in order to allow 20 hours for laying out and to have machinework done. This allows 10 hours to apply the parts to the engine and as several parts have already been returned, these final 10 hours are ample to complete application ready for wheeling. Seventy-five hours from the time the engine has been delivered to the erecting pit, the wheels have been applied, trammed, and are ready for the application of the motion work and for valve setting. Twenty hours from this period is allowed for the completion of valve setting. In the meantime the flues have been applied and the boiler shop forces, working on an hourly period system have carried their work along so that the boiler test can be applied 80 hours after the engine has been stripped.

Allowing 35 hours to complete the engine after the valves have been set we find that the engine has gone through the shop in a total of 140 hours. This may seem a rather long period, but these figures are given for a modern heavy locomotive and are taken from averages.

It was found that it had been taking practically two weeks to get a set of eccentrics through the machine department, but with the hourly time period this was reduced to 40 hours from the completion of the stripping period to the delivery of the eccentrics to the erecting shop ready for application. Machines which had been idle were put in commission to insure a steady flow of finished machine jobs to the fitting and erecting shops, and after all, it is the steady and regular return of such parts that governs shop output.

When regulated in this manner the shop output was increased nearly 100 per cent with less workmen, and as there were still many items to be corrected, the output could be increased over this figure. While it had been possible in some special cases to turn two engines per month off the same pit, it was found that to do so, some other engine was being neglected, and the desired regular output was obtained by adhering strictly to the hourly period system.

The wheel gang instead of finishing one set of wheels today and then skipping two or three days before delivering other finished wheels to the erecting shop, has been developed so that they give a set of finished wheels just as fast as the stripping gang strips an engine. The driving box gang can average a set of boxes in 10 hours, though we find that each workman only averages about seven hours per set. The reason for this is that much roundhouse work, for which provision must be made, is handled by this gang.

Today all locomotive repair work is heavy and a working schedule should take this important item into consideration. The day when one man could lift a driving box onto the journal is past, and shop equipment should be provided to save man power.

When the question of output requirements is considered, the benefit of this system to the higher officers is apparent, as they have the complete possibilities before them in a table showing the total work hours required for each type of engine and each class of repairs.

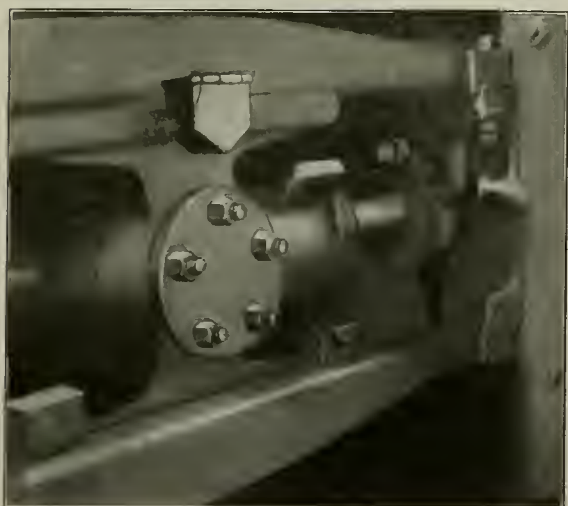
A good system without a mass of detail to follow will make the work easier for the men, simplify the duties of the foremen and practically double the output.

In making up any system, do not lose sight of what constitutes a fair day's work. Strike an average fair to the workmen and fair to the employer and the workmen will take pride in keeping their department on the honor roll. And as a word of caution, the man selected for the establishing of any system should be transferred from another shop, as a man selected to install a system in his own shop is likely to ignore certain points which might have great influence on its success.

CROSSHEAD PIN ON RUSSIAN BUILT LOCOMOTIVES

BY LIEUT. JAMES GRANT
Russian Railway Service Corps., American Expeditionary Forces in Siberia

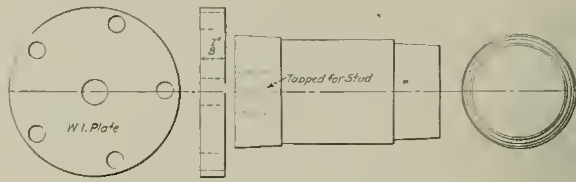
The accompanying sketch and photograph show a design of crosshead pin in general use on Russian built locomotives. This style of pin has some advantages over the one so commonly used on American locomotives, and is probably easier to make and apply. The crosshead is bored with the large



The Crosshead Pin Applied

end of the taper to the outside, so that the pin is applied from the outer side of the guides. On most American locomotives the pin is applied from the inside, and it is quite a difficult operation for a mechanic to reach behind the guide bars and apply the heavy pins that are now used on large locomotives.

Another advantage is that it is securely held in place by a neatly machined plate, with five 7/8-in. studs. On American locomotives the pin is drawn and held in place by large nuts, which necessitate enormous wrenches and consequent difficulty in drawing the pin tight.



Details of the Russian Crosshead Pin

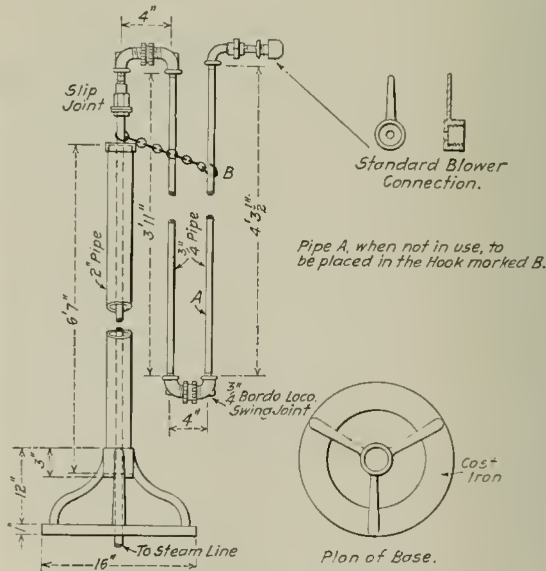
Provision is made for extracting the pin by a 1½-in. hole, tapped in its center so that it can be easily pulled with a plate and a stud.

BLOWER PIPE STAND FOR ROUNDHOUSES

BY E. A. MILLER

A blower pipe stand has been devised for use in roundhouses which has proved to be very convenient for quickly connecting up the blower to engines that have just been fired.

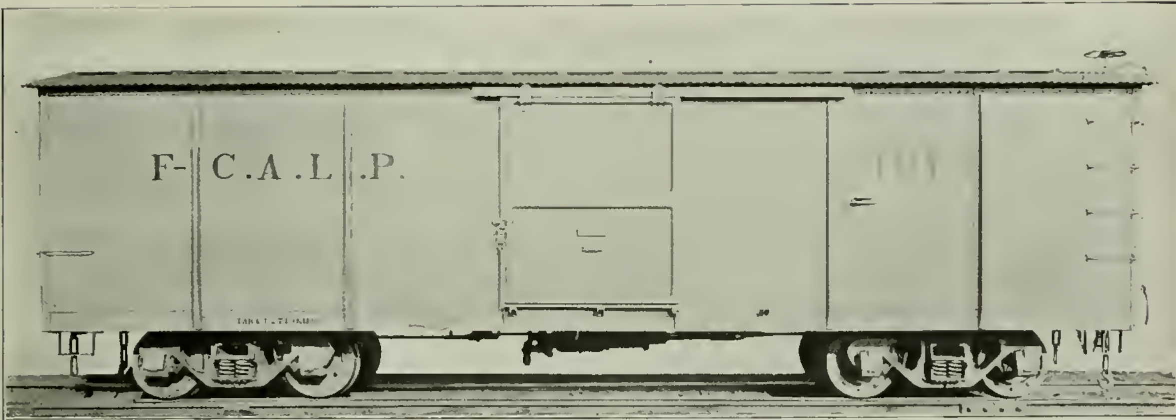
The stand consists of a cast iron base holding a 2 in. wrought iron pipe through which passes a ¾ in. pipe connected with the steam line. Other pipes with elbows, unions and swing joints are installed to give the scope necessary and a standard blower connection is attached to the outer



The Stand with Piping Held by the Chain

end. These stands are placed between the stalls in a roundhouse so that the device may be connected to the blower on either side. The 2 in. wrought iron pipe serves as a stand for the steam piping and at the same time affords protection against being burned to any one who might otherwise come in contact with the heated pipes.

When the device is not in use it can be swung back and held close to the stand by the chain, as shown in the illustration.

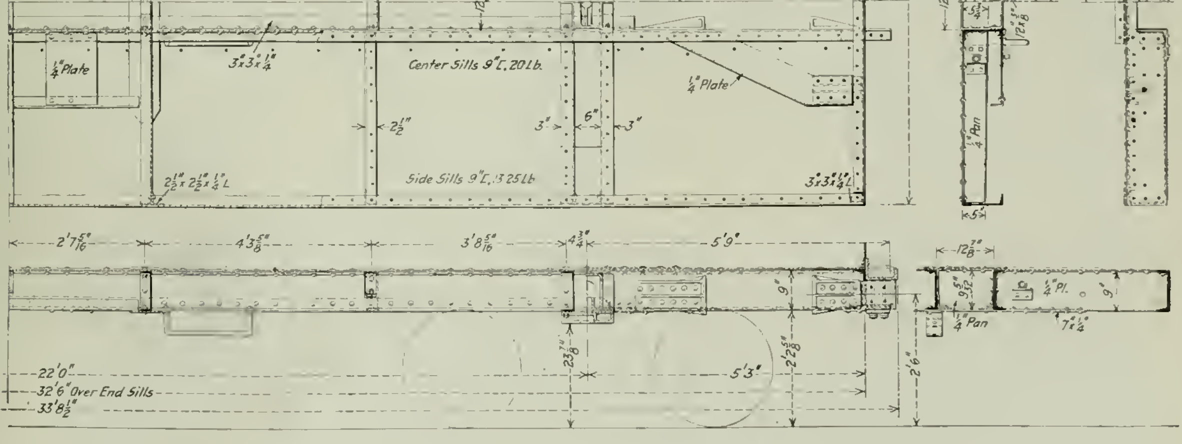


Narrow Gage Steel Box Car for Use in Chile

Box Cars For Chilean Railway

Steel Construction of American Type for Meter Gage Line, Including M. C. B. Couplers and Trucks

THE Arica-La Paz Railroad, part of the Chilean Government system, has recently received from the Pullman, Ill., works of the Pullman Company an order of 100 steel box cars for operation on a meter gage line. These cars will be found of interest to American readers because of the extent to which American standards and lb. The principal dimensions are, length inside, 32 ft. 6 in.; width inside, 7 ft. 9 in.; height, 6 ft. 2 3/16 in. from the top of the sill to the plate; height, rail to top of running board, 10 ft. 6 5/16 in.; height, rail to center of drawbar, 2 ft. 6 in., and distance center to center of trucks, 22 ft. The transverse contour of the roof is circular and the height



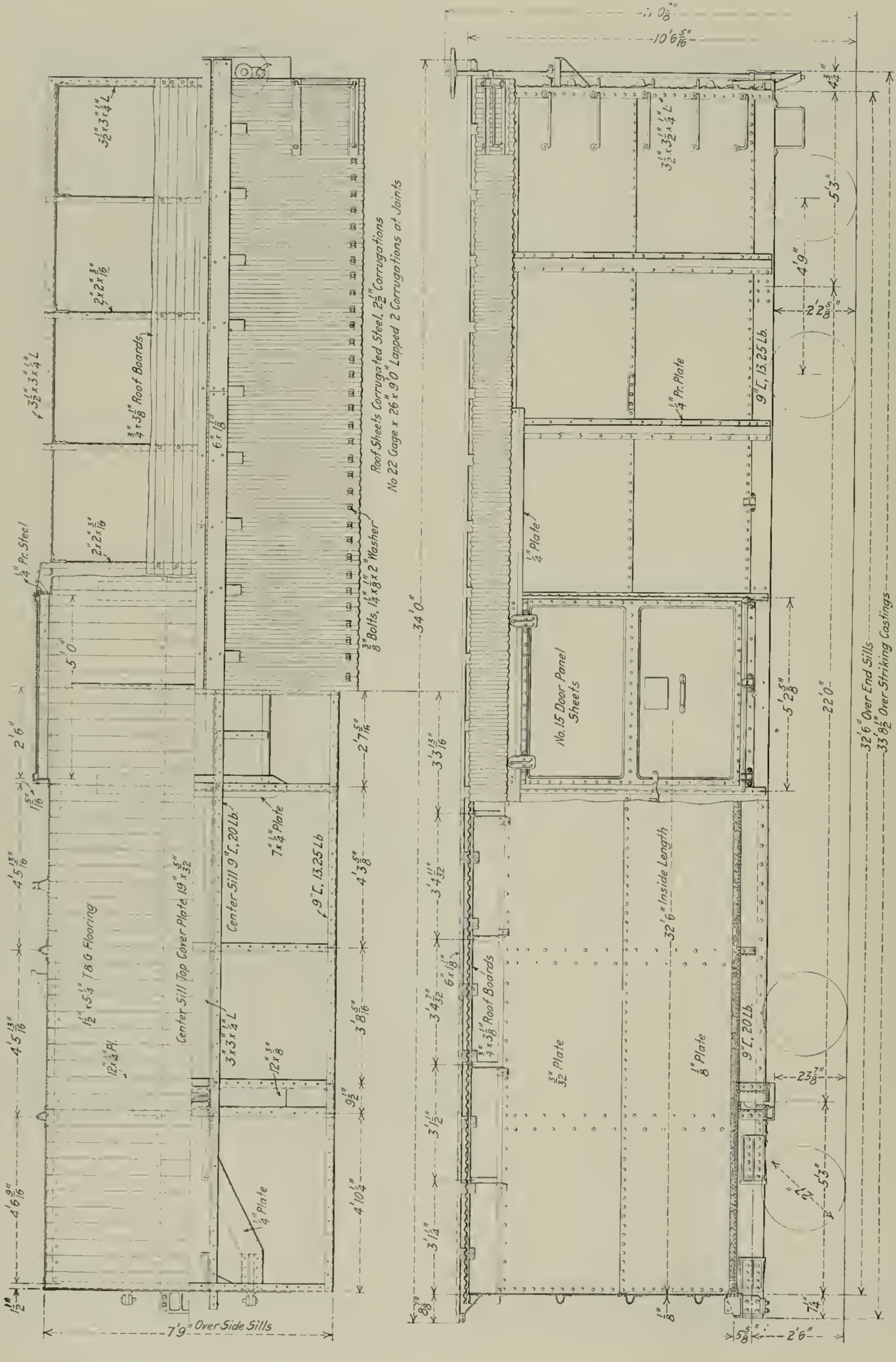
Underframe of the Narrow Gage Box Car

types of design have been embodied in them, as well as because of several interesting features not usually incorporated in the design of cars for use on this continent.

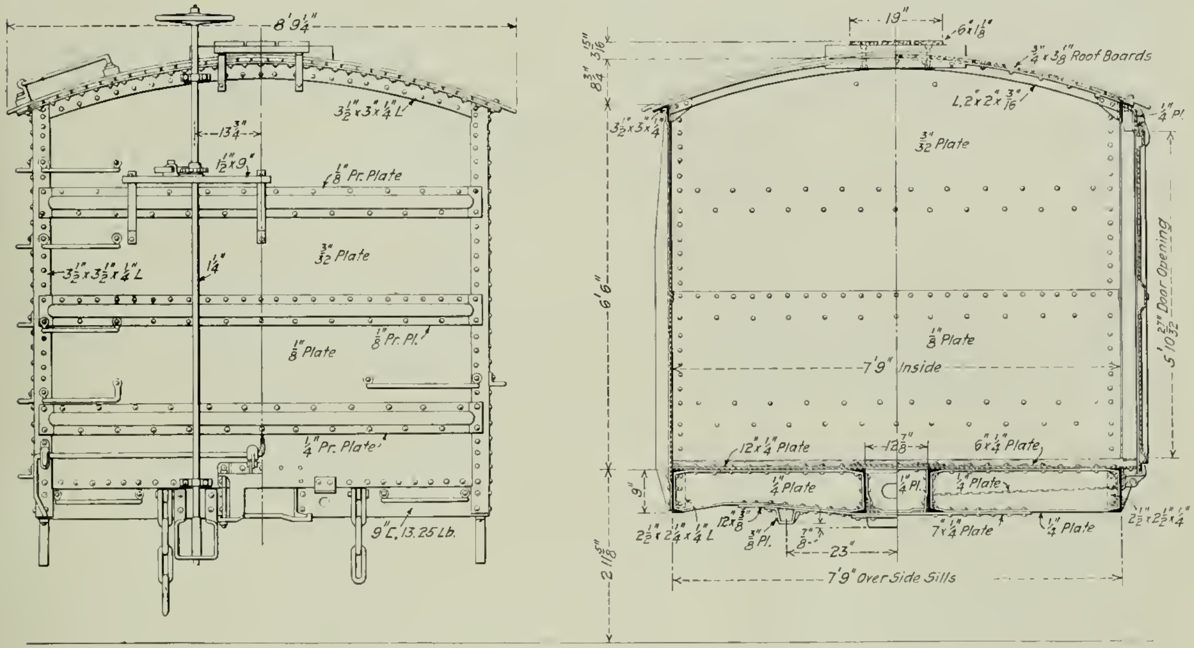
These cars have a rated capacity of 25,000 kilos, or 55,000 lb., and have a light weight of 12,719 kilos, or 28,000

under the carline at the center of the car is 6 ft. 11 3/32 in. The cars have the customary arrangement of side doors, which are about 5 ft. wide by 5 ft. 10 in. high. The cars are practically of steel construction throughout.

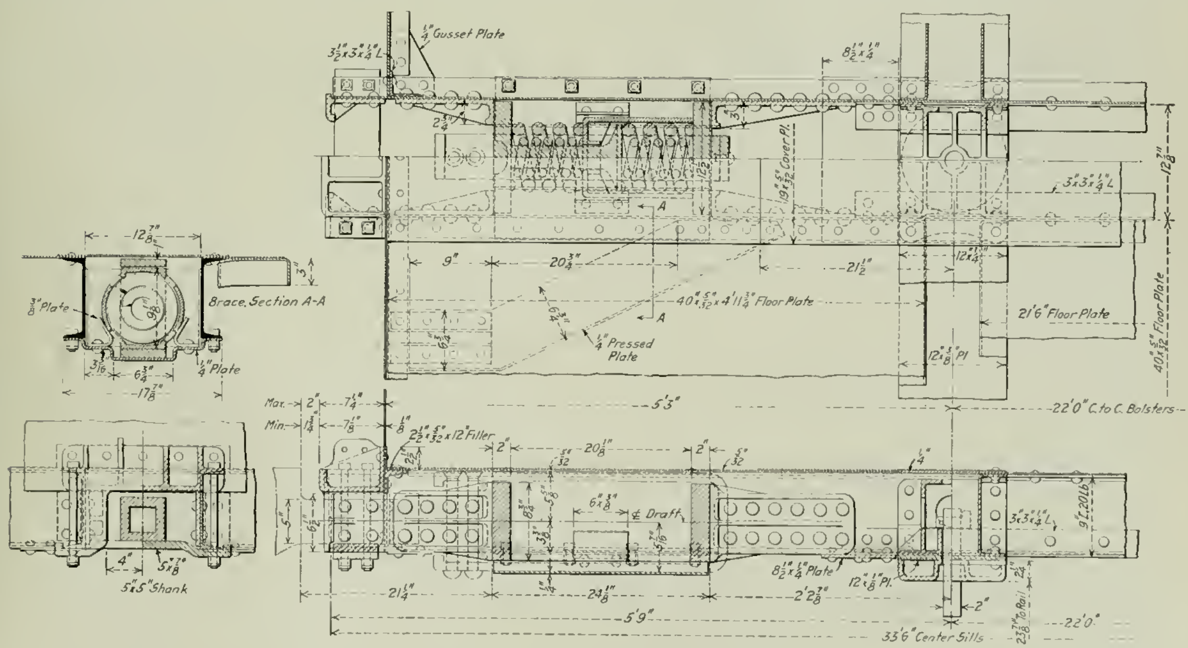
The main members of the underframe are of structural



Plan and Elevation of the Arica-La Paz Steel Box Car section with bolsters and intermediate diaphragms of pressed steel. The center sills are of 9-in., 20-lb. channel section while the side sills are 9-in., 13.25 lb. channels. The center sills are placed back to back with a spacing of 12 7/8 in. and have a top cover plate of 5/32-in. material, 19 in. wide, which extends continuously between points 21 1/2 in. toward the ends of the car from the center line of the bolsters.



End Elevation and Half Sections of the Chilean Box Car



Twin Spring Draft Gear Arranged in Tandem

The bolsters are of the double plate type and are built up of two pressed steel channel sections placed 6 in. back to back, with a filler casting between the center sills. A 1/4-in. top cover plate 12 in. wide, extending continuously across the car, is riveted to the top flanges of the web members. The bolsters are completed by a bottom cover plate 3/8 in. thick, extending across the center sills to points 13 1/4 in. from the face of the side sills. A 5/32-in. plate is riveted to the top flanges of the center sills between the bolster cover plate and the end sills.

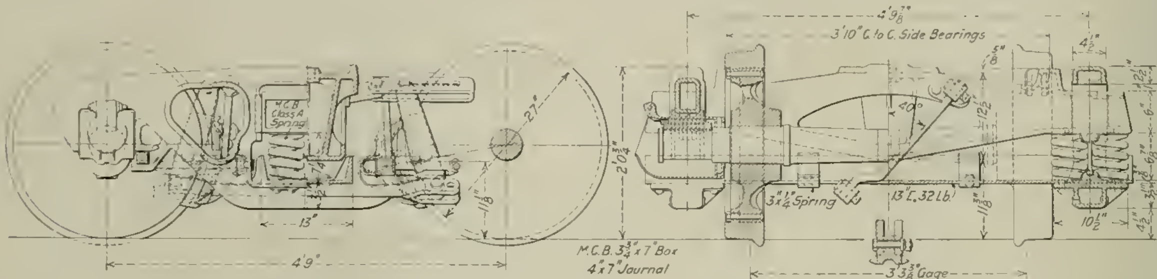
There are four intermediate diaphragms. The two center diaphragms are located in line with the side door posts and are of single plate pressed steel section with a uniform depth of nine inches. Both top and bottom flanges are reinforced with ¼-in. plates which extend only part way across the car. The top plate is six inches wide while the lower one is seven inches wide. The other two diaphragms are also of the single plate type of ¼-in. pressed channel section but have a uniform depth of only five inches. These are about five feet inside of the center of the bolsters.

One of the interesting features of this design is the draft gear, which in general is of the type ordinarily used in America, but involves an unusual arrangement of the draft springs. In principle the gear is of the twin spring type, but the springs are arranged in tandem. The direct action of the two springs is secured by an ingenious arrangement of sleeve and spool, which carries the reaction of each spring directly from one follower plate to the other. The forward spring is slipped over a spool, the rear end of which bears against the forward end of the rear spring, thus carrying the forward reaction of the rear spring directly against the forward follower plate. The backward reaction of the forward spring is similarly carried to the rear follower plate by means of a spool which encircles the rear spring.

The body is made up of 3½-in. by 3½in. by ¼-in. angle corner posts, channel section door posts of ¼-in. pressed steel and four special flanged U-section intermediate posts on each side of the car. The steel sheathing on the sides and ends of the car are laid in two courses which are joined with a lap joint. The upper course is of 3/32-in. plate while the plate in the lower course is ⅛-in. thick. The ends of the car are reinforced with three flanged U-section steel pressings, placed horizontally.

The carlines are 2-in. by 2-in. by 3/16-in. angles, the horizontal flanges of which are riveted to the tops of the 3½-in. by 3-in. by ¼-in. angle side plates. The roof is surfaced with corrugated steel sheets of No. 22 gage material, which is laid over a course of ¾-in. by 3⅛-in. longitudinal roof boards bolted to the carlines. These sheets are secured near the eaves by ⅜-in. bolts, which pass through the horizontal flange of the side plate and the outside roof boards. The entire underframe is covered with 5/32-in. steel plates on which the floor is laid. The floor is of 1½-in. tongued and grooved yellow pine material.

The truck is of the Buckeye pedestal type for 3-ft. 3⅜-in. track gage and has a wheel base of 4 ft. 9 in. The wheels are steel tired on cast iron centers and are 27 in. in diameter. They are mounted on axles with 4-in. by 7-in. journals which run in M. C. B. standard 3¾-in. by 7-in. journal boxes. The cast steel bolster is carried on M. C. B. class A springs. The truck has a height of center plate under load of 23⅞ in.



Buckeye Narrow Gage Pedestal Truck for the Arica-La Paz Box Cars

The cars are equipped with M. C. B. type automatic couplers and in addition are provided with safety chains on either side of the drawbar. The cars are fitted with ladders and grab irons, practically in accordance with American practice. Westinghouse automatic air brakes, schedule HC-812, are used on these cars, and in addition they are provided with an auxiliary train line for direct control of brake pressure from the locomotive, with the pressure retaining valve cut out.

THE LONGITUDINAL DISTURBING FORCES IN LOCOMOTIVES

BY EDWARD L COSTER
Assoc. Am. Soc. M. E.

In the American Engineer and Railroad Journal for December, 1905, there appeared an article by the present writer entitled "Comparative Magnitude of Longitudinal Disturbing Forces in a Cole Balanced Compound and a Single Expansion Express Locomotive," in which several important formulae were presented, but their derivation was not explained. It is the object of the present paper to derive these

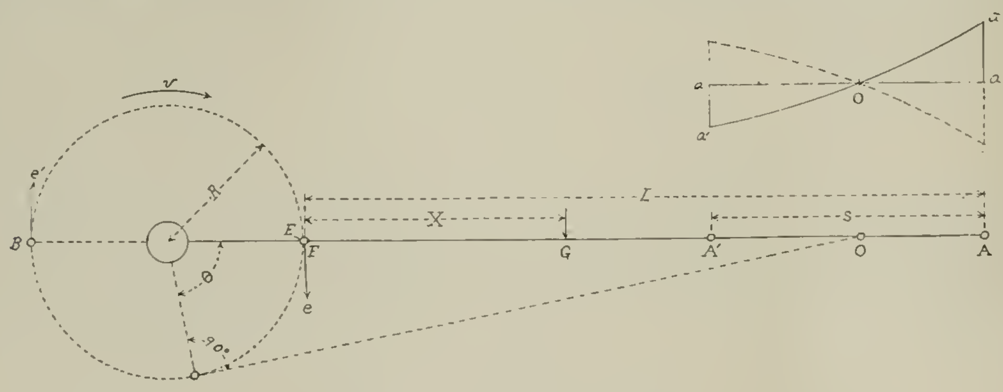


Diagram on Which Discussion Is Based.

formulae in the simplest possible manner, without the use of the higher mathematics which are usually employed for this purpose. The practical application of these formulae is illustrated in the article above referred to.

In the diagram, let *F* and *B* denote the front and back dead points, respectively.

Let s = piston stroke in inches.
D = driving wheel diameter in inches.
R, r, = crank radius in feet and inches, respectively.
L, l, = length of connecting rod in feet and inches, respectively.
X, x, = distance of center of gravity, *G*, of connecting rod from crank pin center in feet and inches, respectively.
W = weight of unbalanced revolving parts (if any) in pounds.
W' = weight of reciprocating parts in pounds.
W" = weight of connecting rod in pounds.
V = speed in miles per hour.
v = uniform crank pin velocity in feet per second.
P = horizontal inertia of unbalanced revolving parts at *F* and *B* in pounds.
P'_f = inertia of reciprocating parts at *F* in pounds.
P'_b = inertia of reciprocating parts at *B* in pounds.
P''_f = horizontal inertia of connecting rod at *F* in pounds.
P''_b = horizontal inertia of connecting rod at *B* in pounds.
C = centrifugal force of connecting rod at *F* and *B* in pounds.
g = gravitational acceleration = 32.16 ft. per sec. per sec.

Since the centripetal acceleration of the crank pin is $\frac{v^2}{R}$ ft. per sec. per sec.

$$P = \frac{Wv^2}{gR}.$$

$$\text{But } \frac{v^2}{gR} = \frac{\left\{2\pi\frac{r}{12} \times \frac{5280V \times 12}{\pi D \times 60^2}\right\}^2}{32.16\frac{r}{12}} = \frac{8.602r^2\frac{V^2}{D^2}}{2.68r} = 3.2r\frac{V^2}{D^2} = 1.6s\frac{V^2}{D^2}$$

$$\text{Therefore } P = 3.2Wr\frac{V^2}{D^2} = 1.6Ws\frac{V^2}{D^2} \quad \ldots\ldots(1)$$

At "diameter speed," V = D, hence for this case

$$P = 3.2Wr = 1.6Ws \quad \ldots\ldots(1a)$$

$$\text{For } L = \text{infinity}, \; P'_f = P'_b = \frac{W'v^2}{gR}$$

But for a finite connecting rod, as the crank pin passes *F*, the center point, *E*, of the rod's crank pin bearing, describes an infinitely small arc of a circle, *e*, about the axis of the cross-head pin *A*. The circumferential velocity of *E* is v, and if L = nR, the forward (centripetal) acceleration of *E* is $\frac{v^2}{nR}$ ft. per sec. per sec. But the backward acceleration of the crank pin is $\frac{v^2}{R}$; hence, since *E* is constrained to travel in the crank pin path, its total backward acceleration, and therefore that of *A* and the reciprocating parts, is

$$\frac{v^2}{R} + \frac{v^2}{nR} = \frac{v^2}{R}\left\{1 + \frac{1}{n}\right\} = \frac{v^2}{R}\left\{1 + \frac{R}{nR}\right\} = \frac{v^2}{R}\left\{1 + \frac{R}{L}\right\}$$

Therefore:

$$P'_f = \frac{W'v^2}{gR}\left\{1 + \frac{R}{L}\right\} = 3.2W'r\frac{V^2}{D^2}\left\{1 + \frac{r}{l}\right\} = 1.6W's\frac{V^2}{D^2}\left\{1 + \frac{r}{l}\right\} \quad ..(2)$$

and at diameter speed:

$$P'_f = 3.2W'r\left\{1 + \frac{r}{l}\right\} = 1.6W's\left\{1 + \frac{r}{l}\right\} \quad \ldots\ldots(2a)$$

As the crank pin passes *B*, the point *E* again describes an infinitely small circular arc, *e'*, about *A'*, the forward acceleration of *E* being $\frac{v^2}{nR}$ as before. But since the direction of this acceleration is now the same as that of the crank pin, the resultant forward acceleration of *E*, and therefore that of *A'* and the reciprocating parts is:

$$\frac{v^2}{R} - \frac{v^2}{nR} = \frac{v^2}{R}\left\{1 - \frac{1}{n}\right\} = \frac{v^2}{R}\left\{1 - \frac{R}{nR}\right\} = \frac{v^2}{R}\left\{1 - \frac{R}{L}\right\}$$

Therefore:

$$P'_b = \frac{W'v^2}{gR}\left\{1 - \frac{R}{L}\right\} = 3.2W'r\frac{V^2}{D^2}\left\{1 - \frac{r}{l}\right\} = 1.6W's\frac{V^2}{D^2}\left\{1 - \frac{r}{l}\right\} \quad \ldots(3)$$

and at diameter speed:

$$P'_b = 3.2W'r\left\{1 - \frac{r}{l}\right\} = 1.6W's\left\{1 - \frac{r}{l}\right\} \quad \ldots\ldots(3a)$$

As the crank pin passes *F* and *B*, the center of gravity, *G*, of the connecting rod attains its maximum circumferential velocity of $v\frac{L - X}{L}$ ft. per sec. about *A* and *A'*, respectively; hence at these points the forward (centripetal) acceleration of *G* is:

$$\frac{\left\{v\frac{L-X}{L}\right\}^2}{L-X} = \frac{v^2(L-X)^2}{(L-X)L^2} = \frac{v^2(L-X)}{L^2} \text{ ft. per sec. per sec.}$$

But at *F* the backward acceleration of *A* is $\frac{v^2}{R}\left\{1 + \frac{R}{L}\right\}$ therefore the resultant backward acceleration of *G* is:

$$\frac{v^2}{R}\left\{1 + \frac{R}{L}\right\} - \frac{v^2(L-X)}{L^2}$$

At *B* the forward acceleration of A' is $\frac{v^2}{R}\left\{1 - \frac{R}{L}\right\}$, therefore total forward acceleration of *G* is:

$$\frac{v^2}{R}\left\{1 - \frac{R}{L}\right\} + \frac{v^2(L-X)}{L^2}$$

Consequently the general expression for the maximum horizontal acceleration of *G* in feet per second per second, is:

$$\frac{v^2}{R}\left\{1 \pm \frac{R}{L}\right\} \mp \frac{v^2(L-X)}{L^2}$$

the upper and lower signs corresponding to the front and back dead points, respectively. Thus by reducing we have:

$$\frac{v^2}{R}\left\{1 \pm \frac{R}{L}\right\} \mp \frac{v^2(L-X)}{L^2} = \frac{v^2}{R} \pm \frac{v^2R}{RL} \mp \frac{v^2L}{L^2} \pm \frac{v^2X}{L^2} = \frac{v^2L^2}{RL^2} \pm \frac{v^2RL}{RL^2} \mp \frac{v^2LR}{RL^2} \pm \frac{v^2XR}{RL^2} = \frac{v^2L^2}{RL^2} \pm \frac{v^2RL}{RL^2} \mp \frac{v^2RL}{RL^2} \pm \frac{v^2XR}{RL^2} =$$

$$\frac{v^2L^2 \pm v^2XR}{RL^2} = \frac{R}{v^2}\left\{\frac{L^2 \pm XR}{L^2}\right\} = \frac{v^2}{R}\left\{1 \pm \frac{XR}{L^2}\right\}$$

Hence

$$P''_f = \frac{W''v^2}{gR}\left\{1 + \frac{XR}{L^2}\right\} = 3.2W''r\frac{V^2}{D^2}\left\{1 + \frac{xr}{l^2}\right\} = 1.6W''s\frac{V^2}{D^2}\left\{1 + \frac{xr}{l^2}\right\} \quad .(4)$$

and at diameter speed

$$P''_f = 3.2W''r\left\{1 + \frac{xr}{l^2}\right\} = 1.6W''s\left\{1 + \frac{xr}{l^2}\right\} \quad \ldots\ldots(4a)$$

$$P''_b = \frac{W''v^2}{gR}\left\{1 - \frac{XR}{L^2}\right\} = 3.2W''r\frac{V^2}{D^2}\left\{1 - \frac{xr}{l^2}\right\} = 1.6W''s\frac{V^2}{D^2}\left\{1 - \frac{xr}{l^2}\right\} \quad \ldots(5)$$

and at diameter speed

$$P''_b = 3.2W''r\left\{1 - \frac{xr}{l^2}\right\} = 1.6W''s\left\{1 - \frac{xr}{l^2}\right\} \quad \ldots\ldots(5a)$$

Equations 4 and 5 indicate that the horizontal inertia of the connecting rod is increased at *F* and diminished at *B* by a quantity $\frac{W''v^2}{gR} \times \frac{XR}{L^2}$, whose direction of action is forward in both cases, it appearing under the negative sign in equation 5 as the main force of inertia in this case is really negative, as it acts backward. Hence, since at both dead points the centrifugal force of the connecting rod, $C = \frac{W''v^2(L-X)}{gL^2}$, acts backward, it tends to neutralize this irregularity. Thus:

$$\frac{W''v^2}{gR} \times \frac{XR}{L^2} - \frac{W''v^2(L-X)}{gL^2} = \frac{W''v^2}{gR} \times \frac{XR}{L^2} - \frac{W''v^2}{gR} \times \frac{R(L-X)}{L^2} = \frac{W''v^2}{gR}$$

$$\left\{\frac{XR}{L^2} - \frac{R(L-X)}{L^2}\right\} = \frac{W''v^2}{gR}\left\{\frac{XR - RL + XR}{L^2}\right\} = \frac{W''v^2}{gR} \cdot R\frac{2X - L}{L^2}.$$

which is the difference between the two forces, or the amount that is not neutralized. Complete neutralization evidently requires that $R\frac{2X-L}{L^2} = 0$ for which condition $2X = L$, or $X = \frac{L}{2}$; i. e. *G* must be at the center of the connecting rod. If it be nearer *E*, as is always the case, 2X<L, and the result is negative, or *C* more than neutralizes the irregularity of the horizontal inertia of the rod.*

Consequently, when the effect of *C* is included,

$$P''_f = \frac{W''v^2}{gR}\left\{1 + R\frac{2X - L}{L^2}\right\} = 3.2W''r\frac{V^2}{D^2}\left\{1 + r\frac{2x - l}{l^2}\right\} = 1.6W''s\frac{V^2}{D^2}$$

$$\left\{1 + r\frac{2x - l}{l^2}\right\} \quad \ldots\ldots(6)$$

and at diameter speed:

*See Henderson's "Locomotive Operation," 2nd edition, pp. 39-41.

$$P''_f = 3.2W''r\left\{1 + r\frac{2x-1}{l^2}\right\} = 1.6W''s\left\{1 + r\frac{2x-1}{l^2}\right\}\ldots\ldots\ldots(6a)$$

$$P''_b = \frac{W''v^2}{gR}\left\{1 - R\frac{2X-L}{L^2}\right\} = 3.2W''r\frac{V^2}{D^2}\left\{1 - r\frac{2x-1}{l^2}\right\}$$

$$= 1.6W''s\frac{V^2}{D^2}\left\{1 - r\frac{2x-1}{l^2}\right\}\ldots\ldots\ldots\ldots(7)$$

and at diameter speed

$$P''_b = 3.2W''r\left\{1 - r\frac{2x-1}{l^2}\right\} = 1.6W''s\left\{1 - r\frac{2x-1}{l^2}\right\}\ldots.(7a)$$

For the values of $\frac{L}{R}$ obtaining in locomotive practice, the point *O*, of maximum horizontal velocity and consequent zero acceleration of both the reciprocating parts and the center of gravity of the connecting rod, corresponds very approximately to the position in which the axis of the rod is normal to the crank, i. e., when $AO = R + L - \sqrt{L^2 - R^2}$, and the crank angle, θ, is that whose tangent $= \frac{L}{R}$. Hence if we so locate point *O* either on the atmospheric line of a pair of superimposed indicator diagrams, or the base line of a net piston pressure diagram, which lines are represented by *aa'*; from the extremities of this line lay off to the scale of the indicator spring, the vertical distances *aa* and *a'a'*, equal respectively to $P'_f + P''_f$, and $P'_b + P''_b$, per square inch of effective piston area, and describe a circular arc through the points *aoa'*, then *aoa'* represents with quite sufficient accuracy for most practical purposes the curve of horizontal inertia of the reciprocating parts and connecting rod with which to correct the indicator, or effective pressure diagrams, when determining the force transmitted to the crank pin during the backward stroke. For the forward stroke, the inertia curve (shown dotted) is of course simply the reflection of the curve *aoa'*.

TEAMWORK OF ENGINEMEN AND FIREMEN*

BY M. A. DALY

General Fuel Supervisor, Northern Pacific

Engine crews dispose of nearly all of the coal used on the railroads of the United States. Approximately 95 per cent of all railroad coal passes through their hands. Nearly 130,000,000 tons of coal will this year be mined, hauled and placed on the tenders of locomotives. Into the fireboxes about $434,000,000 worth of coal will be shoveled.

Some of the coal mined for the locomotives will not be delivered to the tenders, some of the coal delivered to the tenders will not be thrown into the fireboxes, and some thrown into the fireboxes will not be burned. Coal will be lost from cars en route from mines to coal docks, coal will be lost off the side rails, decks and end sills of the tenders, and unburned coal will be lost through the grates and through the smokestacks. A large percentage of those losses are avoidable. Just how much, however, may always be an unknown quantity. Nevertheless, many railroads are now recognizing that such losses are enormous, and that partial prevention is easily possible.

The value of a ton of coal may be carelessly considered in railroad operation, but the cost of each ton will inevitably take its deliberate bite out of the current operating revenues. Each morning in the United States 65,000 locomotives stand ready for service. At the close of each day $1,190,000 worth of locomotive coal has been turned to ashes. Every ton of the coal contains a definite amount of potential draw-bar-pull. How much of it is actually utilized in pulling cars will depend largely on the condition of the locomotive, the manner in which it is operated, and the skill with which the coal is placed on the firebed.

When a locomotive is properly maintained, properly operated and properly fired, it will not only require the least possible amount of fuel, but it will also deliver the highest possible character of service. All three of these points are of direct concern to road foremen and traveling engineers. In fact, these points embody the chief part of the work of those officers, for most railroad executives now hold that the principal duties of road foreman and traveling engineers are to develop economy in the use of fuel. Economical fuel operation is a mark of good railroading. It may be possible, perhaps, to have economical fuel operation without good railroading, but no more is it considered to be good railroading unless there be economical fuel operation.

The locomotive is not a one-man machine. Its operation requires two men. One is occupied in converting water into steam, while the other is manipulating valves which permit the steam to do the work desired. The two men work at the same time. It may almost be said that the steam is being used at the same time that it is being made. There being a limit to the steam storing capacity of the locomotive, when the engineman stops using steam the fireman stops making it. At least such should be the fireman's aim. The fireman should have advance information of the approximate time of closing the throttle, so that he may control the fire accordingly. The engineer should know that the fireman has this information and see that he is guided by it.

Similar information should be common knowledge before starting trains. In this case coal should be placed on the fire a short interval before the locomotive is worked heavily. The successful engineer closely supervises the firing of the locomotive, especially at this time of the trip. The fire must be properly prepared and built up to meet the requirements.

This business of fire prepartion and fire control, like preventing the waste of coal that works out and drops off end sills of tenders, is the work of the fireman, but it is the engineer's responsibility to see that he does it. When you have an engineer who sympathetically and intelligently supervises the firing of a locomotive, you soon have a fireman who becomes more careful in his work. This, of course, is teamwork. Perfect teamwork is easy to recognize, but difficult to develop. First of all, it requires the proper state of mind in the engineer. The engineer must be made to feel his authority and responsibility in directing the work of the fireman. This assumes the full support of his immediate superiors, especially road foremen and master mechanics, and the full support of their superiors.

It is common knowledge that locomotives make trips on which several tons of coal more are consumed than on other locomotives of the same class, on similar runs, in the same service, over the same piece of track, by other crews. The difference in consumption is in the condition of the locomotive or in the work of the engineer or fireman. Habitually close supervision of the fireman makes it much easier for an engineman to suspect that an engine is getting a little "off" on steaming qualities, when he may proceed to locate the trouble and have it remedied.

There is nothing new about these considerations. Teamwork is universally desired. To realize it is the thing for accomplishment. We all acknowledge the existence of irregularities in practice. These should be removed. This paper was written to ask you to give your opinions and convictions as to how these irregularities may best be removed, after we go back to our respective railroads.

*Abstract of a paper presented before the Convention of the International Railway Fuel Association at Chicago, May 19-22, 1919.

Arch Tubes Equivalent to 1,200 Locomotives.—Arch tubes totaling more than one million feet are in active service today. They are capable of evaporating 48,000,000 lb. of water per hour, which is equivalent to the total evaporation of 1,200 large locomotives.—*Erie Railroad Magazine.*

Air Brake Association Meeting

Abstracts of Committee Reports and Papers Presented at the Twenty-Sixth Annual Convention

A BRIEF account of the proceedings of the twenty-sixth annual convention of the Air Brake Association, which was held at the Hotel Sherman, Chicago, May 6 to 9, inclusive, was published in the June issue of the *Railway Mechanical Engineer,* on page 301. The following are abstracts of the more important reports and papers which did not appear in the June issue.

AIR CONSUMPTION OF LOCOMOTIVE AUXILIARY DEVICES*

The committee submitted a report of progress, giving a resumé of the work which had been done. The purpose of the committee's investigation was, (1) to investigate the rate of air consumption of auxiliary devices as found in service on locomotives; (2) to investigate the relation of air consumption by auxiliary devices to compressor operation; (3) to determine if the amount of air used is sufficient to warrant a separation of auxiliary devices from the air brake system, with a separate compressor to furnish air for them; (4) to determine if it is satisfactory to have the auxiliary devices take their air supply from the air brake system, but necessary on this account to install an additional compressor;

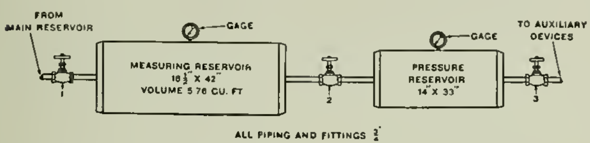


Fig. 1—Measuring Apparatus Used in Standing Tests of Air Operated Auxiliaries

(5) to investigate the cost of compressed air for operating the auxiliary devices used, and (6) to make recommendations with respect to the maintenance of auxiliary devices.

TESTS MADE AND RESULTS

While the data given here do not cover the subject completely, they will at least serve to give a conception as to what the use of air operated auxiliary devices on locomotives may mean in the ordinary practice of busy railroads. It is to be expected that this report will be regarded as a report of progress, and it is hoped that the work of the committee will be continued for the ensuing year.

The investigation covered in this report naturally divides itself into two parts, *viz.*, standing and running tests. The standing tests were made on locomotives in roundhouses, and consisted in measuring the amount of air used by the auxiliary devices operated while the locomotives were standing. The running tests were made on freight engines working over the road in service, and consisted of the continuous measurement of air used by the auxiliary devices in operation while the engine was running. The standing tests involved a total of 48 engines, and the running tests were made with six engines. A total of 489 individual tests were made, the results of which have been classified and arranged for the purposes of this report.

The locomotives used during these tests were not selected, nor were any locomotives inspected before the tests were made. It was desired to test the equipment just as it might happen to be available so that the data would be representative of average operating conditions. Furthermore, the standing tests were made at three division points and involved the equipment on four different divisions. The running tests were conducted on two road divisions.

Standing Tests—The standing tests involved measuring the amount of air used by the various auxiliary devices with the locomotive at rest. The form of apparatus for making this measurement is shown in Fig. 1. It consisted of two tanks connected as shown, the larger being designated as the measuring reservoir and the smaller as the pressure

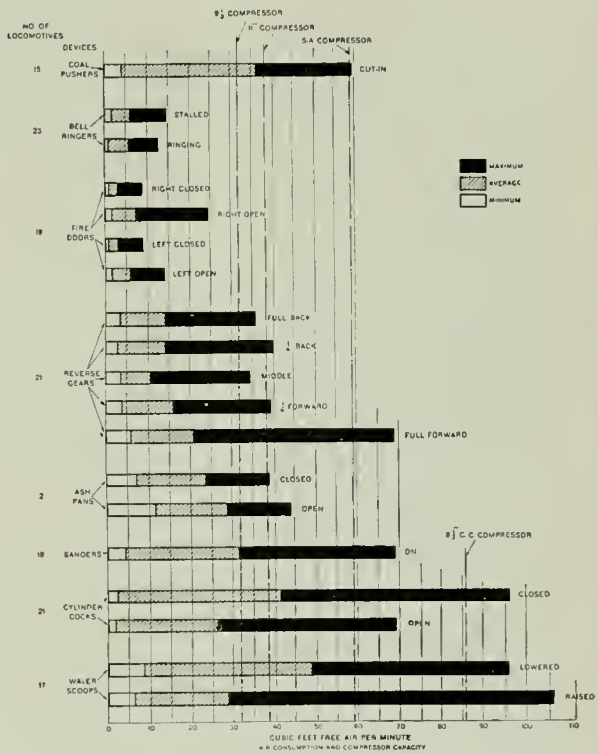


Fig. 2—Results of Standing Tests of Auxiliary Devices on All Locomotives

reservoir. The measurement of the air used by each auxiliary device was accomplished in the following manner:

The auxiliary device to be tested was disconnected from the main reservoir on the locomotive and reconnected to the measuring apparatus at globe valve No. 3. A connection was likewise made from the main reservoir on the locomotive to the measuring reservoir at globe valve No. 1. The air was measured by opening valve No. 3 and manipulating globe valves Nos. 1 and 2. The operator of valve No. 2 regulated that valve so that a constant pressure of 70 lb. was maintained in the pressure reservoir as the supply of air pressure to the auxiliary device under test. The operator of the main reservoir valve No. 1 opened this valve so as to charge the measuring reservoir up to the main reservoir pressure of the locomotive, usually 40 to 50 lb. higher than the constant pressure in the pressure reservoir. This operator

*The meaning of the term "air operated auxiliary devices on locomotives," as used in this report, can be defined as referring to all air operated devices on locomotives which are not a part of the air brake system, such as air operated fire doors, bell ringers, reverse gears, sanders etc.

then closed valve No. 1 and noted the time required for the pressure in the measuring reservoir to drop any given amount during the time it was supplying air continuously to maintain the constant pressure in the pressure reservoir.

The air consumption was calculated as follows:

$$\frac{20 \text{ (drop in measuring reservoir)}}{14.7 \text{ (atmospheric pressure)}} = 1.36 \text{ drop in measuring reservoir expressed in atmospheres.}$$

1.36 atmospheres × 5.76 (volume of measuring reservoir) = 7.83 cu. ft. of free air supplied during the test.

$$\text{Then } \frac{7.83 \times 60 \text{ (No. of sec. in one min.)}}{78 \text{ (time of test in sec.)}} = 6.03 \text{ cu. ft. per minute.}$$

The standing tests made on all auxiliary devices have been classified and arranged according to the type of locomotive upon which they were found, and the results are shown in graphic form in Fig. 2. Each figure on the chart shows the minimum, average and maximum rates of air consumption of all the auxiliary devices of the several types tested. The results for passenger locomotives are based on the standard passenger train reservoir pressure of 130 lb., although the actual tests were made at a constant pressure of 70 lb. In every case the data were converted from the 70 lb. basis to give the equivalent rate of air consumption at 130 lb. in the following manner:

$$\frac{\text{Rate of leakage, cu. ft. per min.}}{\text{Absolute press. on test (84.7 lb.)}} \times \text{Absolute press. on locomotive (144.7 lb.)} = \text{rate of leakage on engine when main reservoir pressure is 130 lb. instead of 70 lb.;}$$

that is, the leakage is taken as proportional to the absolute pressures. The data for freight engines are based on 100 lb. main reservoir pressure, standard for freight service.

It will be noted that all charts have the capacity of air compressors indicated on them for convenient comparison with the rates of air consumption given. These values for compressor capacity are based on the rate of air delivery established by the Interstate Commerce Commission's compressor condemning tests, as shown in Table 1.

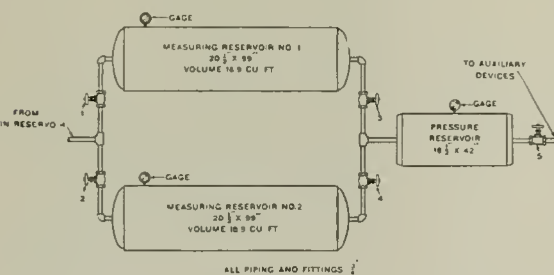


Fig. 3—Measuring Apparatus Used in Running Tests

Table 1—Compressor Capacities Based on I. C. C. Condemning Tests

Type of compressor	Delivery rate, cu. ft. free air per minute, 60-lb. pressure
9½-in.	32
11 -in.	37.5
5-A	59
8½-in. C.C.	86

Running Tests—Running tests were made with the object of determining the rate and total amount of air used by the auxiliary devices while the locomotive was working in regular service. An apparatus was devised for measuring continuously the rate and amount of air used, and is shown diagrammatically in Fig. 3. This apparatus is similar to that described above and shown in Fig. 1; the only difference being that two measuring reservoirs are used, with the object of permitting the measurement of air to go on continuously.

This apparatus was manipulated so that while the air was being measured by the dropping pressure in one reservoir, the other reservoir was allowed to charge from the main reservoir in order to be ready to start measuring the supply of air to the pressure reservoir as soon as the air pressure in the first measuring reservoir was exhausted.

The measuring apparatus was installed in a caboose which was run at the head end of the train next to the engine. The piping was so arranged that with either end of the caboose toward the engine, connections could be made to the main reservoir and the auxiliary devices on the locomotive under test.

The length of running tests covered in this report varied from 3½ to 8 hours, or the time required to make a fast freight movement over a division of 131 miles. The running tests made were six in number and can be divided into two classes, *viz.:* (a) Running tests in which the rate of air consumption was measured for the reverse gear only, and (b) running tests in which the rate of air consumption was measured for all auxiliary devices.

Fig. 4—Results of Freight Service Running Tests

Three tests of each kind were made, and each test was made during a full trip of an engine in regular service on fast freight. The running tests are, of course, of a great deal more importance than the standing tests, in that they show the rate of air consumption as it varies during the working time of the locomotive, and it is the judgment of the committee that more tests of this kind should be made.

The tests herewith presented do not provide sufficient data for basing definite conclusions, but they do show how the leakage of auxiliary devices will vary with running conditions on the road, and that cases do exist in which the air consumption is unreasonably high, if not actually dangerous, in the sense that it increases the possibilities of an engine failure as the result of overworking the air compressor.

The running test data are shown plotted in graphic form in Fig. 4. Each of the six tests is represented by a line which shows how the rate of air consumption varied throughout the trip. The three solid lines represent tests made on all auxiliary devices, and the three dotted lines represent the tests made in which the air consumption was measured for the reverse gear only. Additional lines are shown on the charts to indicate the capacity of different air compressors in order that comparisons between the compressor air capacity and the rate of air consumption can readily be made. All of the engines used in the six tests plotted on this chart were of the same class, and were equipped with two No. 5-A air compressors and the following air operated auxiliary devices: reverse gear, double fire doors, bell ringer, sander, water scoop and cylinder cocks.

The tabulation below shows the total amount of free air used and the average rate of using during each of the six running tests shown in Fig. 4.

Locomotive designations	Auxiliary devices	Total cu. ft. free air used during trip	Cu. ft. free air used per min.
A	Rev. gear only..........	5,665.2	11.84
B	Rev. gear only..........	4,939.8	10.55
C	Rev. gear only..........	1,809.62	4.50
D	All devices..............	14,750	46.93
E	All devices..............	7,761.2	23.13
F	All devices..............	1,738.4	8.17

Cost Data—Fig. 5 has been made up from the running test data to show the relative cost of maintaining auxiliary devices at the minimum, maximum and average conditions of leakage found during these tests. The first two figures of this chart show the minimum and average rates of air consumption for the three tests in which the reverse gear only was measured and the three tests in which all auxiliary devices were measured. These values were obtained from the test data by dividing the total amount of air used during the trip by the total time of the trip in minutes. The actual values used are shown in the last column of the preceding tabulation. The remaining figures in Fig. 5 give the relative

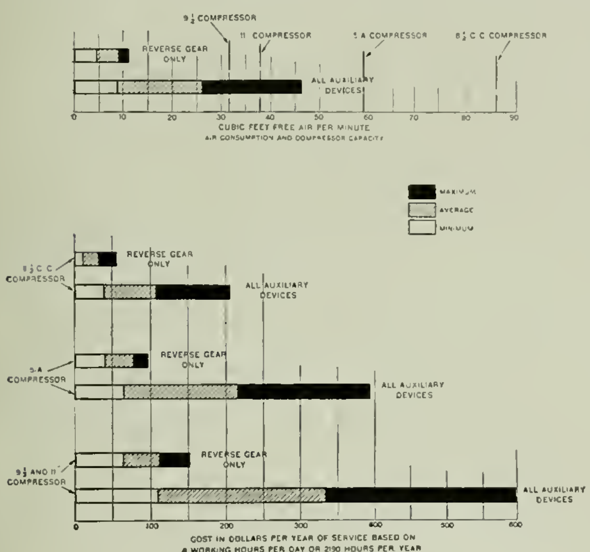


Fig. 5—Cost Data Based on Running Tests of Various Types of Air Compressors

minimum, maximum and average cost for compressed air when using various types of air compressors. There are two figures for each type of compresser, one for the tests made with reverse gears only, and the other for the tests made with all auxiliary devices. These figures show the relative cost of supplying the compressed air required under the various conditions, based on the following assumptions: (1) That the average working time for locomotives is 6 hr. per day, or 2190 hr. per year; (2) That the rate of evaporation is 7 lb. of water per pound of coal; (3) That the price of coal on the tender is $2.00 per ton, or $1.00 per 1,000 lb.; (4) That the rate of steam consumption in pounds of steam used per 100 cu. ft. of free air compressed, is in accordance with the values given in Table II. These values have been determined from a series of steam consumption tests made on each of the types of air compressors indicated.

Table II—Steam Consumption of Locomotive Air Compressors

Type of compressor	Lb. of steam, at 200 lb. pressure per 100 cu. ft. free air compressed: To 100 lb. main res. pressure	To 130 lb. main res. pressure
9½-in. and 11-in	68	76.25
5A	44.7	51
8½-in. C. C......................	24	25

The cost comparison figures are based upon the above assumptions only, no consideration being given to such factors as the cost of handling coal on engines, cost of water, depreciation of boiler plant and compressor plant, etc. These considerations have been omitted because the committee does not have sufficient data to accurately determine them. It is obvious that these factors would increase the costs shown, and the chart figures can therefore be regarded as the minimum conservative values.

A detailed account of the results of the tests of individual appliances was given in the report. The theoretical or computed air consumption did not account for even the minimum consumption that was found during the standing test, proving that the greatest part of the air used was wasted through leakage due to improper maintenance of the devices. The committee believes that it would be worth while to continue the test with a view to establishing more complete data upon which performance standard and condemning tests could be made.

Conclusions

(1) Auxiliary devices under average conditions were found to use too much air.

(2) Conditions frequently exist where compressor capacity may be exceeded by the demands of the auxiliary devices.

(3) Some of the data justify the conclusion that auxiliary devices should be operated separately from the air brake system. On the other hand, some of the data show that with proper maintenance this conclusion might not be warranted.

(4) Under some of the conditions shown by these data, it would not be satisfactory to connect the auxiliary devices to the air brake system and increase the compressor capacity accordingly, unless the air brake main reservoir is protected from the consequences of excessive air requirement by the auxiliary devices.

(5) Cost basis data show that better maintenance would be profitable.

(6) Standards of performance, including maximum permissible leakage, should be established upon which to condemn devices unfit for service.

(7) Means should be devised for checking and testing the performance of auxiliary devices.

Recommendations

The committee recommended that its work be continued and this report be regarded only as a report of progress; that the data be made more complete by investigations on individual railroads, conducted as outlined in the report, such investigations to be reported to the chairman of this committee; that steps be taken to secure better maintenance of auxiliary devices; that further experiments be made with the object of devising satisfactory means for testing, and satisfactory standards of performance which can be applied to show whether the device is fit for service; and that consideration be given to the plan of operating the auxiliary devices at a pressure lower than that carried in the air brake system main reservoir. This plan would effect a large saving in air used, but would require a separate air supply reservoir with means provided for controlling the reduced pressure.

The report was signed by C. H. Weaver (N. Y. C.), chairman; C. B. Miles (Big Four), W. W. White (M. C.), and R. E. Miller (W. A. B. Co.).

Discussion

Great interest was shown in the results of the test and numerous opinions were advanced as to the cause of excessive leakage in auxiliaries and the method that should be used to overcome it. The practice of operating power reverse gears by steam when handling locomotives around the roundhouse was condemned by several speakers, who stated that steam destroyed the packing in the cylinders and caused excessive leakage. Some roads are now equipping metal disk power reverse systems with metal packing rings. T. F. Lyons (N. Y. C.) brought out the fact that leakage in the auxiliary devices might interfere with the proper operation of the brake even though it did not result in a large waste of air. The loss due to leaks in water scoop cylinders did not cause excessive air consumption because the cylinder is operated at infrequent intervals. However, in approaching water tanks the scoop is usually dropped at the same time as the brakes are released and excessive leakage in the water-scoop cylinder might seriously interfere with the recharging of the auxiliary reservoir.

M. C. B. AIR BRAKE DEFECT CARD

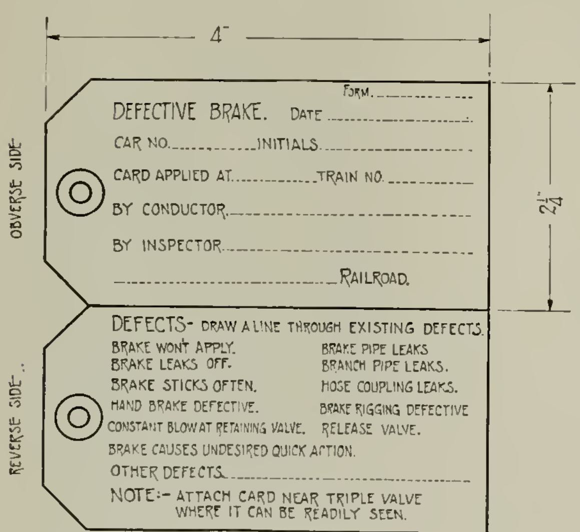
BY JAS. ELDER

General Air Brake Inspector, Chicago, Milwaukee & St. Paul

The United States Railroad Administration, Fuel Conservation Division, in Circular No. 13, of August 31, 1918, issued by Eugene McAuliffe, manager, presents 15 specific recommendations made by an Air Brake Association committee. Recommendation No. 9 is as follows: "A rule should be put into effect that trainmen must apply an M. C. B. standard air brake defect card in cases where defects develop en route or for brakes cut out by them; defect to be checked off on back of card."

The M. C. B. card shows careful thought, but the changed conditions since its last revisions demand certain alterations to meet present requirements. Some believe the brake defect card has outlived its usefulness, basing this on (a) the great difficulty in getting it applied where needed; (b) on incoming brake tests rendering it less necessary; (c) and some object because of the appearance occasional trains would present if all cars with defective brakes were carded. Assuredly the brake defect card should either be used to better advantage or discontinued.

If a defect card is yet needed and is practicable after having simplified the card, it will be very desirable to have



Suggested Revision of M. C. B. Air Brake Defect Card

mandatory instructions as to responsibility for its application. As this car is a detail of repairing, for which car men are responsible, *car men should be primarily responsible for its application;* that is, before a departing train is released from the blue signals, the inspectors should have either repaired or carded every defective brake. With this insured, it would be fair to insist that the departing train crew should card every defective brake delivered at the next terminal. However, as the incoming test should invariably be made, and as this would disclose to inspectors all defects except with cut-out brakes, it is submitted that if train men are required merely to card properly every brake brought in cut-out, all needs will be met, and the work of getting cards used by them will be lessened in a rational manner.

If one road cards all defective brakes not repaired and a connecting line does not, the former will be subjected to an unfair comparison; hence, that if real value is to be obtained from the defect card, its full and similar use must be obligatory on all roads in interchange traffic. If the defect card is to be continued the following additional means for bettering the results obtained should be adopted. The card and its use should be simplified, and then action looking toward its obligatory and uniform use by all railways in interchange service should be taken. The stub should be omitted. If it were possible to get the stubs filled out and forwarded, they would merely burden the mails and the offices. The reasons warranting omission of the stub also justify dropping from the card all matter pertaining to its use after the defect has been repaired. The size proposed is 4 in. by 2¼ in.

With all-air trains, a defect which prevents placing a certain car between other air brake cars, puts it back of the caboose. This advertises the defect on arrival at the next terminal, and as it must not go farther until repaired, there is now no use for the second card, as there was when the present M. C. B. card was designed. Where an existing defect does not require air pressure to locate it, such as one with either the hand brake or the foundation brake, it is plainly undesirable to elaborate the card by specifying the various points where such defects commonly develop. The revised card submitted is here illustrated.

DISCUSSION.

Practically all who discussed the paper agreed that the defect card gave valuable information, but that considerable difficulty was found in getting train men to use them. There was a marked difference of opinion regarding the advisability of eliminating the stubs. The association adopted a motion recommending the adoption of the air brake defect card revised as suggested in the paper, the use of this card to be confined to train men and inspectors in departure yards.

HOLDING STANDING FREIGHT TRAINS AND CARS ON GRADES

BY R. J. WATTERS

Assistant Air Brake Inspector, Northern Pacific

While many, if not most roads with steep grades have recognized the possible great dangers incident to holding standing trains and cars on grades, and have generally issued rules or instructions to guard against such dangers, yet the fact that even on such roads there is a strong tendency on the part of some officials as well as of the men in the train service to gravitate toward easier and more dangerous practices, and the further fact that many accidents from lack of the right practices occur on roads with grades too light to include them under the term mountain or steep grade roads, amply justify the Air Brake Association's careful consideration of this subject.

As before implied, probably the greater danger is due to laxness in the daily enforcement of rules and instructions on this subject. Observance of these requires more forethought and co-operation on the part of engine and trainmen to reduce the time and labor for compliance; and even then the latter will be greater than by the easier but more dangerous ways. Familiarity with steep grades, and the many deviations from safe practices that can occur so generally without an accident following, tend constantly toward habits which, unless checked regularly, will eventually result in disaster. One of the most common and dangerous of these is failure to release and recharge the train brakes promptly after stopping on a grade, which should invariably be done whether or not the engine in control is to be cut off.

A general superintendent of a large road with several long and steep grades, expressed this matter well by the statement that it was necessary about every six months to instruct each superintendent having a steep grade, to report how well safety precautions against runaways were being observed, but not to do so until he had the trainmaster and the traveling engineer make a special investigation and report. He said that without this, a serious accident invariably occurred in time.

The following definite instructions and recommendations are submitted on the subject of this paper:

As soon as a train is stopped on a grade, brakes should be released and recharged at once. If the engine from which brakes are being operated remains attached, and keeps the train charged, as it then should, it may be held with the independent brakes; that is, by keeping the independent or the straight air brake valve in application position. An exception is where the engineer is to leave the engine. In this case enough hand brakes to alone hold the train should be applied. This should be proved by having all automatic and independent brakes off and, if the compressor may be kept running, then the independent brake should be reapplied and its brake valve handle left in application position.

If the engine from which the train brakes are being operated is to be cut off, enough hand brakes to alone hold the train, should be applied, but the trainmen should not commence to apply them until the automatic brakes are released. Where retaining valves are in use, none need be turned down, but no hand brakes should be applied until one minute after train brake release is begun.

Hand brakes used to hold cars or a train on a grade should be applied at the down-grade or lower end, thereby assuring against any car starting if uncoupled. All slack should be in, against the applied hand brakes, as well as all automatic brakes off (see previous exception about retaining valves) before cutting off an engine.

If, with the engine in control of the train cut off, another engine is to be detached, as a helper or pusher, its engineer should first cut in, release and recharge the train brakes, then release the independent brake so as to be certain the train will stand after the engine is cut off. While remaining with the train the independent brake should be kept applied on each of any such other engines.

With a descending train, the final reduction to bunch the slack, as the stop is being completed, should be followed, during the wait of one minute after release is begun before commencing to apply hand brakes (at the head end), by reversing and pushing the slack in as much more as possible, then holding the train with the independent brake while the hand brakes are being applied.

With an ascending train, see that the slack is in before cutting off by allowing it to drop back gradually, with train brakes off, until the train will stand with no aid from the engine in control. It should be held by hand brakes applied at the rear, aided by the independent brake of each other engine in the train.

If a break-in-two, or burst hose occurs on a grade, immediately apply more than enough hand brakes to alone hold the train until its brakes are again recharged. If it is a descending train, and a coupling is damaged that will take some time to repair, and if the portion of the train with the engine (ahead) can be backed so as to couple the detached hose, it should be done and the train kept recharged during any necessary wait while obtaining a repair part, as a knuckle or pin, or if a delay must ensue before putting the damaged car elsewhere, as where this occurs where the car may be switched out or to the rear end.

It should be noted that the air brakes are off before applying hand brakes on cars set out on a grade, and on level track as well, sufficient to hold them. It is not necessary to bleed the air from auxiliary reservoirs of cars so set out as long as the air brakes are off when the hand brakes are applied. In addition to the foregoing any rules regarding blocking cars should be complied with. Hand brakes applied when the car air brakes are set, may result in broken chains when the air brakes leak off, especially dangerous with one or two cars. Even where this exceptional failure does not occur, they will often be so difficult to release as to necessitate the delay and waste of air required to apply the air brakes to aid in releasing them.

HOW CAN ENGINEMEN AND TRAINMEN ASSIST IN AIR BRAKE MAINTENANCE?

BY H. A. GLICK
Air Brake Inspector, Bangor & Aroostook

While locomotive engineers are not primarily responsible for air brake design and maintenance, they can, nevertheless, aid materially by making careful and specific reports about air brake conditions on their locomotives requiring attention. Many of the defects that may arise in the course of a trip, especially leakage in the numerous pipe connections that contain air pressure, due to vibration or improperly connected pipe joints, can be discovered better by the engineer while the locomotive is under steam and air pressure and in his charge. His co-operation in reporting intelligently and reliably all brake troubles is essential to good maintenance.

Whenever trouble arises with any air brake part on an engine, the man that delivers the engine should properly book on the work report the actual defect that exists, but should not book non-essential or imaginary defects; for by so doing he causes a great deal of unnecessary work on the part of the roundhouse force. The time so used is simply wasted and might be used to good advantage performing essential work on this and other engines. Before taking an engine out the engineman should know that all air brake parts perform their functions, and not take it for granted that they do.

The trainman can assist and he should be duty bound to do so, by following the general air brake instructions now existing on all railroads, by taking greater interest in them, and consequently, in his own welfare. If he does not follow the general instructions, he should be made to do so by proper measures from his superiors, and also by the urging of his fellow workmen. He should be made to recognize the right and wrong of his part in air brake maintenance. There are times when the brake is cut out for no reason. No brake should be cut out of service unless a defect exists; then whoever cuts the brake out should specify the trouble on a a proper air brake defect card and tie the card to the cross-over pipe on the car.

Trainmen should do everything possible to stop brake pipe leakage, as this leakage causes hardship on the air compressor, takes away from the engineer the ability to properly control the amount of the application, contributes to brakes sticking and prevents the maintenance of sufficient brake pipe pressure. The practice when separating cars of closing but one angle cock, allowing the brakes on cars back of the separation to apply in emergency, should be discontinued. When separating cars, both angle cocks should always be closed and hose should always be separated by hand. When opening angle cocks on the charged portion of train, they should be opened slowly to prevent brakes from applying in emergency. When switching cars they should not be allowed to strike any harder than three miles per hour. Coupling cars at a greater speed creates shocks, which in turn are absorbed by the unions in brake pipe connections, causing brake pipe leakage. The cordial co-operation of enginemen and trainmen in the matter of air brake maintenance is very necessary in order to get the best results.

DISCUSSION

The necessity for co-operation between the trainmen and enginemen and the air brake repair men in order to promote proper maintenance, was emphasized by several speakers. One road reported good results by requiring trainmen to pass an examination on the proper handling of brakes.

THE AIR BRAKE SUPERVISOR'S RESPONSIBILITIES TO THE STORE DEPARTMENT

BY W. H. CLEGG
Air Brake Supervisor, Canadian National

The air brake supervisor's interest in this question starts with his discovery that some standard practice or regulation relative to air brake maintenance is not being adhered to, or that a locomotive or car is being held out of service awaiting the arrival of certain repair parts by reason of lack of knowledge or failure of the local officers to anticipate the requirements, and this in spite of the fact that less important stations are overstocked with the very parts that are needed to release the locomotive or car in question, or permit of adherence to standard practice covering repairs. Thus it appears that the supervisor in order to help himself must of necessity assist the stores department. The following should form the basis of the air brake supervisor's assistance to the storekeeper: (1) Providing suitable places for the care and preservation of repair parts in stock. (2) Advising as to the various repair parts and quantities required to be carried in stock at general stores. (3) Approving of sub-requisitions placed with general stores. (4) Periodical inspection of divisional stores and assistance to divisional storekeepers. (5) Preventing the accumulation of a surplus stock of repair parts that are seldom used. (6) Advising the general storekeeper where a surplus of repair parts are found so that same may be transferred to other terminals or returned to general stores.

The recommended assistance as outlined above requires but a small portion of the supervisor's time and his often unsolicited efforts will eventually be fully appreciated.

RAILROAD ADMINISTRATION NEWS

The director general has accepted from the War Department the custody of 100 locomotives which were originally constructed for the Russian government, and has arranged until further notice to continue the operation of that equipment on federally operated lines.

Prior to the present arrangements, the lines using these locomotives were obligated to the War Department for a rental based upon $45 per locomotive per day. The amount payable was considerably in excess of that required under the present agreement, which is 6 per cent per annum upon a valuation of $55,000 per locomotive, or an annual rental of $3,300 per locomotive from the date it went into service, or pro rata for any fractional part of a year. The agreement for the use of these locomotives provides that they shall be fully maintained at the expense of the director general.

COST OF TRAIN AND LOCOMOTIVE SERVICE

The total cost of train service, including locomotive service, shows a steady decrease as compared with preceding months, although increases as compared with last year, according to the monthly reports compiled by the Operating Statistics Section. For the month of April it was 112.7 cents per 1,000 gross ton miles, as compared with 119.5 in March and 126.5 in February. The cost of locomotive service per locomotive mile in April was 115.2 cents, as compared with 98.5 cents in April, 1918; 119.2 cents in March, 1919, and 120.7 cents in February. The cost of train service per train mile was 162.2 cents, as compared with 141.7 in April, 1918, 167.5 cents in March, 1919, and 169.3 cents in February, 1919. The increase in the cost of locomotive service in March this year over March last year was 17 per cent, and the increase in the cost of train service was 14.5 per cent. All items of cost show increases as compared with last year. The figures are reported by roads and by regions. The combined averages for all regions are as follows:

	April, 1919	April, 1918
Cost of locomotive service per locomotive mile	115.2	98.5
Locomotive repairs	39.4	30.6
Enginehouse expenses	9.6	6.8
Train enginemen	18.9	18.1
Locomotive fuel	43.6	40.2
Other locomotive supplies	3.7	2.8
Cost of train service per train mile	162.2	141.7
Locomotive repairs, Enginehouse expenses	55.5	43.0
Locomotive fuel	49.4	46.2
Other locomotive supplies	4.2	3.3
Train enginemen	21.4	20.8
Trainmen	25.3	23.9
Train supplies and expenses	6.4	4.5

	April, 1919	March, 1919	February, 1919
Cost of train service per 1,000 gross ton miles	112.7	119.5	126.5
Locomotive repairs, Enginehouse expenses	38.6	40.8	43.1
Locomotive fuel	34.3	37.5	40.3
Other locomotive supplies	2.9	3.1	3.4
Enginemen and trainmen	32.4	33.5	34.8
Train supplies and expenses	4.4	4.6	4.8

LOCOMOTIVE FUEL PERFORMANCE

The Fuel Conservation Section has issued a bulletin on locomotive fuel performance for January, February and March, 1919, as compared with the same period of the previous year, which shows an estimated saving in coal consumption by using less coal per 1,000 gross ton miles, or per car mile, amounting to $11,263,774. This is based on incomplete returns covering 76 per cent of the total mileage. In determining the estimated total saving for all roads in a region it has been assumed that the average per cent of saving for the whole region is the same as the average per cent for the roads in that region for which complete information is available. The grand total saving for all regions has been taken as the sum of the regional totals. In freight train service the estimated saving for all roads is $7,773,170. The saving on the roads for which information is available was 12.3 per cent. In passenger service the saving is estimated at $3,530,604, or 12½ per cent. The average cost of coal per ton shows increases in the various regions, as follows: Eastern region, from $3.48 to $3.92; Allegheny region, from $2.92 to $3.00; Pocahontas region, from $2.55 to $2.67; Southern region, from $2.82 to $3.40; Northwestern region, from $3.58 to $3.91; Central Western region, from $3.07 to $3.55; Southwestern region, from $3.13 to $4.14; Grand total, all regions, from $3.16 to $3.57.

The total tons of coal consumed in the three months amounted to 26,191,000 as compared with 30,943,000 in the corresponding period of 1918, and the total cost of coal was $93,503,000 as compared with $97,541,000. In freight service the pounds of coal per 1,000 gross ton miles averaged 220 as compared with 243.7 in the corresponding period of 1918. This is a decrease of 9.7 per cent. In passenger train service the pounds of coal per passenger train car mile averaged 20 as compared with 22½ last year, 11.1 per cent less.

DIRECTOR GENERAL APPEALS FOR EFFICIENCY AND ECONOMY

Walker D. Hines, director general of railroads, has sent the following letter to all officers and employees of railroads under federal control:

"The increased payroll cost, due to improved wages and working conditions, and the increased cost of material and supplies, are now resulting, in connection with the falling off in business, in the United States Railroad Administration incurring heavy deficits in railroad operations.

"For the first four months of this year, these deficits, after deducting the rental due the railroad company, were about $250,000,000 or at the rate of $62,500,000 per month. This critical condition makes it imperative not only that costs shall not increase but also that every effort be made to help the government through every reasonable effort to economize and realize greater efficiency.

"These deficits, so far as they cannot be eliminated through greater economies and through increased business, will eventually have to be offset by increased transportation rates which all should endeavor to avoid.

"I ask every officer and every employee to redouble his efforts to do efficient work, to economize in the use of railroad materials, fuel and other supplies, and to use great care not to injure equipment, tools, office furniture or injure property being transported by the railroad and for which payment must be made if injury occurs, and further than this, to try to encourage others to do the same. Please remember that if you should fail in any of these respects to do what you reasonably could and ought to do you would impose unnecessary cost upon the government. This is true because it is the government which has to bear the loss if there is one or which will receive the profit if any is earned.

"Do not wait for the other fellow to begin this improvement, but begin yourself. Do not decline to help because some other fellow is not helping; turn in and help, and keep on setting the other fellow a good example. You are interested in the great movement for the improvement of the condition of the individual worker. You can aid in that great movement, through efficiency and saving in reducing the cost of railroad operation, because thereby you help to keep down transportation rates, and thereby you help to keep down the cost of living. An increase in rates will give occasion for an increase in prices of what the public consumes and that will mean a new cycle of increasing still further the cost of living. It is to the interest of every man, woman and child in this country that this shall be avoided just as far as possible.

"The government, during federal operation of the railroads, as a result of its nation-wide control, has been able to do much to promote justice to railroad employees through making proper increases in their wages and proper improvement in their working conditions. In the nature of things the result cannot be equally satisfactory to all, involving 2,000,000 employees, because it is not possible in this vast undertaking to satisfy equally every one or even every class of these employees. If any employee feels he has a ground for such dissatisfaction he ought to remember the remarkable strides that have been taken by the government in the last 12 months in the recognition of the just rights of railroad employees, and compare the situation today with what it was in December, 1917, before federal control began. It has been a source of satisfaction to me to aid in this great work. Will you not, in turn, do justice to the government and help sustain my work, as director general, and also justify what has been done for you, by doing all that you can reasonably do to save the government money and to increase the efficiency of your work?

"I sincerely want your assistance in demonstrating that the railroads may be operated successfully even though the wages of its employees have been materially increased."

ORDERS OF REGIONAL DIRECTORS

Cars Rented to War Department.—The regional director, Eastern Region, by circular 500-51A773 promulgates an order from the Division of Operation to the effect that where freight cars are furnished for the War Department, the rental rate is to be uniformly $3 a day, beginning with June 1.

Rental Charges on Equipment.—Order 207 of the Southwestern regional director cancels Orders 183 and 185 previously issued by the Southwestern regional director pertaining to rental charges on locomotives and other equipment and outlines new rates for locomotives, dining cars, locomotive cranes, etc., effective March 1. These rates do not abrogate those named in any contracts of prior execution.

U. S. R. A. Standard Cars; Repairs.—The regional director, Eastern Region, by circular 500-101A771 promulgates a notice from the Division of Purchases that when it becomes necessary to make repairs on standard freight cars, or standard locomotives, orders for material, before being placed, should be referred to the director of the division, H. B. Spencer, Washington, so that any surplus material accumulating at the car plants can be properly distributed.

Safety Appliances on Freight Cars; Time Limit September 1.—The regional director of the Eastern region, by Circular 500-92A767, calls the attention of federal managers to the laws of Congress, the orders of the Interstate Commerce Commission and the rules of the Master Car Builders' Association, designed to insure the complete equipment of all freight cars with the legal safety appliances by September 1, 1919. Foreign as well as owned cars should be equipped under certain regulations.

Flexible Staybolts.—Northwestern Regional Purchasing Committee Bulletin 146 states that the American Locomotive Company has completed the installation of equipment necessary for the manufacture of flexible staybolts and will prepare to furnish them upon order.

New Locomotives Moved Free.—The regional director, Eastern Region, by circular 500-1-106-A783, advises that no freight charges are to be assessed on any class of new locomotives moving from the works of the builders to the purchasing roads, whether under their own steam or dead.

Locomotive Fuel Contracts.—Supplement 17 to Northwestern Regional Purchasing Committee Circular 3 contains the following clause which will be incorporated in all contracts for locomotive fuel: "In the event the railroad is released from federal control before the expiration of this contract, it is understood that the corporate owners have the option to be exercised at their pleasure, of being substituted for the director general of railroads, as to the benefits and obligations of this contract, effective upon the date the owners assume control." This will not require the approval of the corporate companies at this time.

Superheaters.—A. T. Hardin, regional director, Eastern Region, by circular 500-1-97A728A promulgates for the information of federal managers the order of the director of the Division of Capital Expenditures relative to the application of superheaters to locomotives. The order says: "Consideration by the Mechanical Section of the Division of Operation develops that these superheaters will not pay for the cost of application, irrespective of the cost of the material, if the engine is not actually in service by October 1, 1919. It is of course expected that business judgment will be exercised in installing the superheater even after that date, but unless the corporations are willing to stand the operating charge as well as the capital charge for applying superheaters after October 1, 1919, the program should cease as of that date."

Capital Expenditures less than $1,000.—A. T. Hardin, regional director, Eastern Region, by circular 2700-A776, quotes a letter from Washington calling attention to apparent violations of the spirit of the rule which allows federal managers to make expenditures, chargeable to capital, without first consulting the corporation, provided the total expenditure is less than $1,000. Corporations have made protests that many items coming within the limit are really parts of a general program, and do not properly stand by themselves. Among such items are:

(1) Office facilities—typewriters, tabulating machines, desks, etc., spread over eight or ten months. (2) Machine tools evidently part of a general improvement of shop facilities but split up into single purchases. (3) Expenditures incident to heavier rail, divided up into monthly charges, giving no indication of the scope of the program. (4) Fencing,

divided up into short sections * * * (5) Tie plates and rail anchors, divided up into short sections. (6) Rebuilding freight cars reported under the heading of the individual car number. Federal managers are advised to refer such matters, where possible, to the corporate officer, to avoid these objections.

REDUCING EXHAUST NOZZLES TO OVERCOME FRONT END AIR LEAKS*

BY F. P. ROESCH
Supervisor, Fuel Conservation Section, Northwestern Region

The manager of the Fuel Conservation Section, United States Railroad Administration, under date of August 1, 1918, sent out Fuel Conservation Circular No. 8, addressed to all motive power officials concerned with locomotive maintenance. The circular called particular attention to the prevalence of air leaks around the outside steam pipes on superheated steam locomotives at the point where these pipes enter the smoke arch, and advised how these leaks could be detected by means of an ordinary torch test.

While in some instances the recommendations embodied in circular No. 8 were fully complied with, in other cases it was found that proper measures were not used.

The usual methods pursued in taking care of the air leaks around these steam pipes was to pack the opening between the pipe and gland with fibrous asbestos packing, either rope asbestos or plaster being used. Tests have proved that through the action of the exhaust this packing is gradually pulled into the front end, eventually leaving a combined opening around the two steam pipes in the average construction, equal to an orifice 8½ in. in diameter.

These air leaks, of course, do not occur suddenly, consequently the effect on the draft is gradual, and this in turn gradually reduces the steaming qualities of the locomotive. It is because locomotives gradually fail for steam that nozzle bushing is eventually resorted to, as did the steam failures occur suddenly the cause would be investigated and corrected.

In order to determine the exact effect of reducing nozzles and disarranging front end apparatus to overcome the effects of these leaks and to improve the gradually failing steaming qualities of the locomotive, the Fuel Conservation Section authorized a series of tests to be conducted to see what the losses amounted to in increased fuel consumption.

In conducting these tests no particular locomotive was selected, the locomotive test being one in regular chain gang freight service and assumed by all concerned to be in good condition. Draft gages were used in front and behind the diaphragm, in the firebox and in the ash pan. In addition to the draft readings, pyrometer readings were also taken at stated intervals as well as cylinder indicator cards at various speeds and cut off. A dynamometer car was employed in order to register the draw bar pull under varying conditions so that the results obtained would not be based on the tonnage alone, but equated on the train resistance. The tender was cut off, drained and weighed prior to taking coal on each trip. Only the coal consumed in actually pulling the train was taken into consideration, all coal used on sidings and at other stops being used from a separate source.

The locomotive tested was of the light Mikado type and superheated, having cylinders 26 by 30 inches, 63-inch driving wheels, 200 pounds steam pressure, with a calculated tractive effort of 54,720 lb. The tests were conducted over a double track freight division, 91 miles long, having a maximum grade of .67 per cent, the same engine crew being used throughout all tests.

The first trip was made with the locomotive as found. On the completion of this trip, the openings around the steam pipes were packed with rope asbestos, and it was found that the average draft in the front end was raised two inches, as shown by the draft gauge. As this now gave a vacuum in the front end greater than necessary to produce the desired vacuum in the firebox, it was decided to open the nozzle a sufficient amount to reduce this.

On the first trip it was found that the draft gauge in front of the diaphragm registered practically double the height of the column of water as registered by the draft gauge behind the diaphragm, indicating that the draft plate was so adjusted as to offer quite an obstruction to the flow of gases from the firebox to the atmosphere. It was, therefore, decided to raise this plate in order to better equalize the draft.

On the next trip the openings around the steam pipes were again packed with asbestos and front end cement, as inspection on arrival showed that the greater part of the packing applied on the previous trip had pulled out. The nozzle was enlarged ⅛ inch in diameter and the draft plate raised as noted in the preceding paragraph. On this trip the locomotive showed a marked decrease in the consumption of coal per 1,000 G. T. M. equated on the draw bar pull as registered by the dynamometer car. It also showed a decrease in cylinder back pressure at the same speed and cut off, due, of course, to the enlarging of the nozzle.

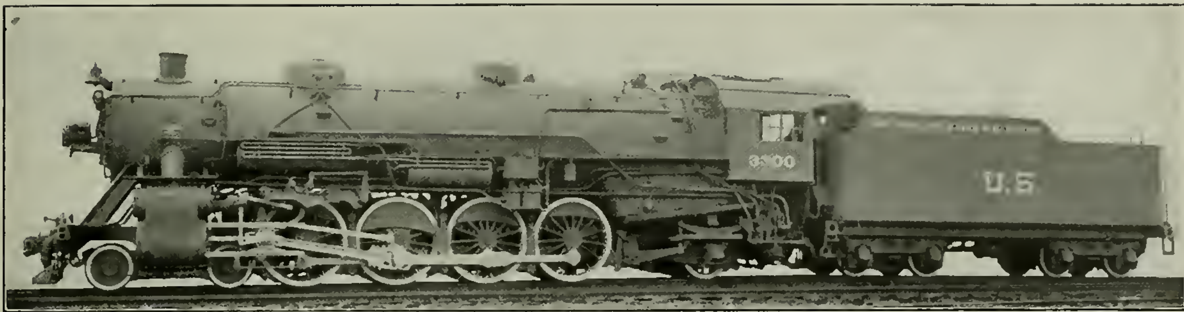
As the front end vacuum was still greater than necessary, it was decided to further increase the diameter of the nozzle on the following trip.

On the next trip the nozzle was enlarged ⅛ inch more in diameter, or a total of ¼ inch above the size originally carried. The draft sheet was left as adjusted on the previous trip. Finding, however, that the packing around the steam pipes had again partially pulled out, it was decided to seal these openings by means of plates made of No. 10 gauge steel, slightly corrugated, the outer circumference of these plates being welded to the smoke arch on the inside of the arch and the inner circumference of the plates welded to the steam pipes. An electric welder was used, thereby permanently sealing these openings. On this trip, while the locomotive did not show any decrease in fuel consumption per 1,000 G. T. M. over the previous trip, it did show an increase in locomotive efficiency, due to the further increase in the size of the exhaust nozzle, and as a point had now been reached where the fuel consumption and locomotive efficiency practically balanced, and it having been decided that any further increase in the size of the exhaust nozzle would affect the steaming of the locomotive to such an extent as to increase the coal consumption, the tests were concluded.

The final results can be briefly summarized in the following statement: Opening the nozzle ¼ inch or 4.5 per cent of the diameter, giving an increase of 9.3 per cent in area, resulted in a decrease in fuel consumption of 14.3 to 21.17 per cent, the comparisons as shown for the different trips wherein the larger nozzle was used being 14.3, 17.2, 18.2 and 21.17 per cent, the difference being due to variations in the quality of coal, weather conditions, etc. The efficiency of the locomotive was increased from 8.1 to 16.5 per cent based on the averages at various speeds and cut off, as shown by indicator cards and dynamometer records. The locomotive steamed equally as well with the larger nozzle as with the one originally used. The raising of the diaphragm resulted in a better distribution of the draft over the fire, and decreased the fuel consumption about 3 per cent.

On the whole, the tests brought out forcibly the necessity of maintaining nozzles with the largest possible diameter consistent with good steaming; of maintaining air tight front ends in order that the large nozzle can be successfully used, and of so adjusting the draft plate as to maintain an even distribution of draft over the entire grate surface, as well as to carry it at such a height as to provide ample area for the free flow of gases from the firebox to the stack.

*Abstract of a paper read at the convention of the International Railway Fuel Association, held at Chicago, May 19-22, 1919.

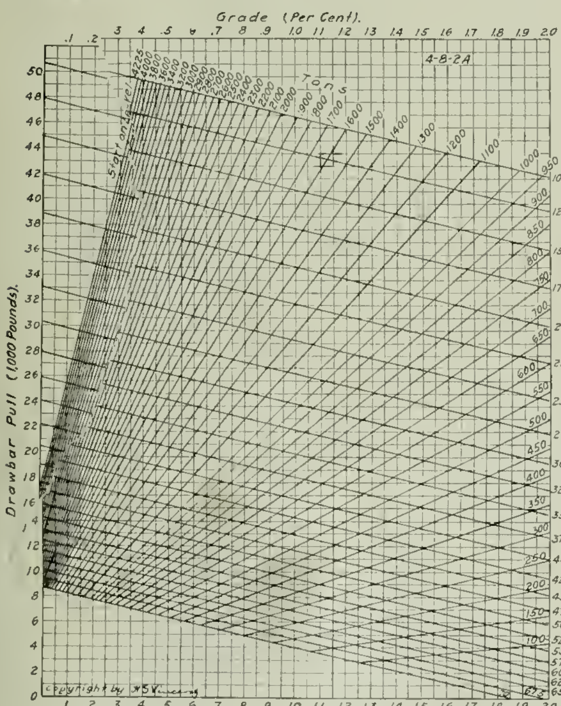


The U. S. R. A. Standard Light Mountain Type Locomotive

Standard Light Mountain Type

Last of the Administration Designs to be Built; Total Weight 327,000 lb.; Tractive Effort 53,900 lb.

THE first of the Railroad Administration standard light Mountain type locomotives has recently been turned out at the Richmond works of the American Locomotive Company and assigned for service on the New York, New Haven & Hartford. This is the last of the standard designs prepared by the Railroad Administration from which



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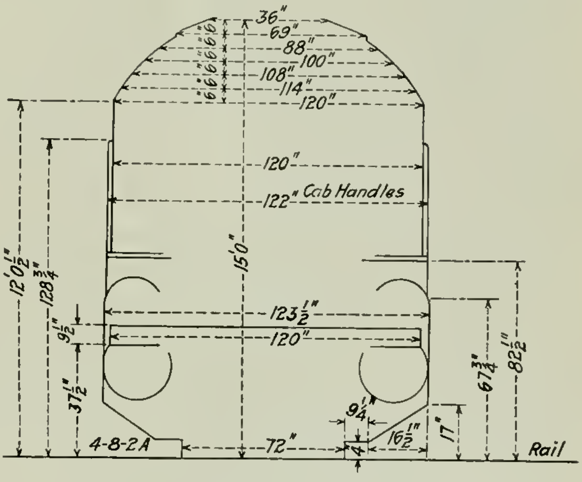
Standard Light Mountain Type Tonnage Rating Chart

locomotives have been built and locomotives of each of the twelve standards are, therefore, now in service.

These locomotives were designed on the basis of rail loads of 55,000 lb. on each driving axle. The actual weight in working order is 327,000 lb., of which 224,500 lb. is on the drivers. The engines produce a tractive effort of 53,900 lb., with a factor of adhesion of 4.2. In the table is presented a comparison of some of the more important dimensions and ratios of the standard light Mountain type with other moderate size locomotives of this type designed to meet conditions which would not permit of the use of maximum axle loads. With the exception of the Canadian Pacific locomotive few Mountain type locomotives designed for passenger service have been built with piston strokes greater than 28 in.

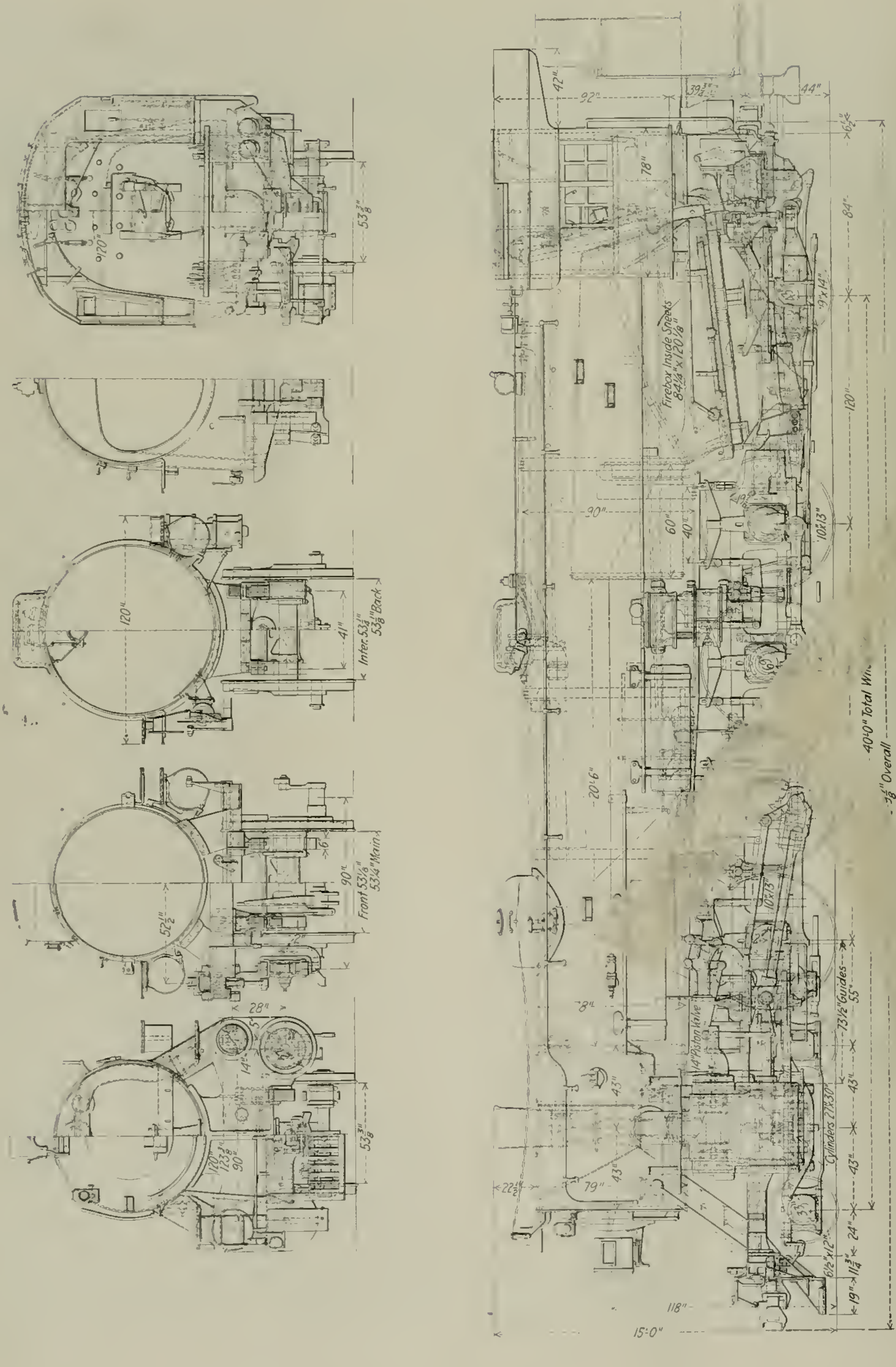


Clearance Diagram for the Light 4-8-2 Type

Comparison of the Principal Dimensions of Light Mountain Type Locomotives

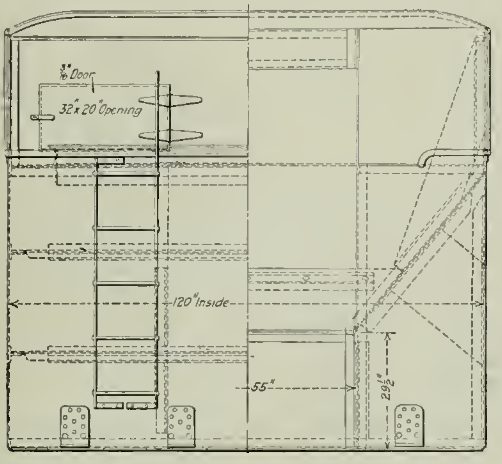
Road	U.S.R.A.	Cent. of Ga.	C.R.I. & P.	Can. Pac.
Year built	1919	1919	1913	1915
Tractive effort, lb.	53,900	47,800	50,000	42,900
Total weight, lb.	327,000	316,000	333,000	286,000
Weight on drivers, lb.	224,500	209,500	224,000	192,000
Diameter of drivers, in.	69	69	69	70
Cylinders, dia. and stroke, in.	27 x 30	27 x 28	28 x 28	23.5 x 32
Boiler pressure, lb.	200	190	185	200
Heating surface, total, sq. ft.	4,121	3,649	4,117	3,667
Superheating surface, sq. ft.	966	961	944	760
Grate area, sq. ft.	70.3	66.8	62.7	59.6
Tractive effort × dia. drivers ÷ equivalent heating surface	667.7	648.0	623.5	625.0
Equivalent heating surface ÷ grate area	79.2	76.2	88.2	80.7
Firebox heating surface ÷ equivalent heating surface	6.2	5.8	3.4	5.5

It will be seen that the light Mountain type has cylinders of 30 in. stroke, which is also the case with the standard heavy



...tion and Sections of the Standard Light ... Type ...omotive

Mountain type locomotive. Except for its greater tractive effort, partly due to the increased cylinder stroke and partly to the greater boiler pressure, the standard light Mountain type compares closely with the Chicago, Rock Island & Pacific Mountain type built in 1913. The heating surfaces



Half End Elevations of the Standard 10,000-Gal. Tender Tank

compare closely, although the standard locomotive has a considerably larger grate than the earlier built locomotive.

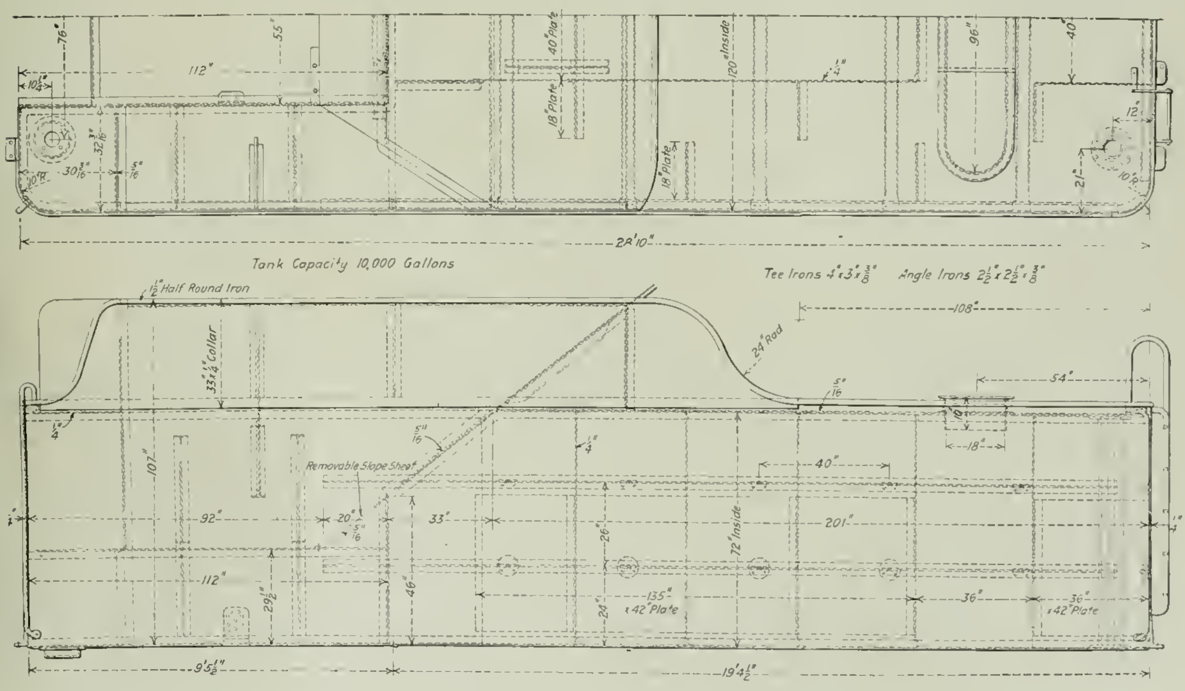
In design the light Mountain type locomotive is essentially the same as the other standard types, following closely the lines of the heavy Mountain and the two Pacific types.

The boiler is of the conical wagon top type, with the dome type A superheater. The same number of tubes and flues are also used in the boiler of the heavy Pacific type locomotive, the length of which, however, is 19 ft., with a 38-in. combustion chamber. The size of firebox at the mudring is the same for both boilers. The boiler of the light Mountain type is fitted with a Shoemaker power operated firedoor.

The frames are similar in design to those of other single unit standard types. The width is six inches and the top rail has a maximum depth of 7⅛ in. over the pedestals, with a minimum of six inches between the pedestals. The lower rail has maximum and minimum depths of 4¾ in. and 4¼ in., respectively. The cylinders are carried on a single front rail of slab section, cast integral with the main frame. This rail tapers under the cylinder fit from a depth of 10⅝ in. at the rear to a depth of 9⅝ in. at the front, the width being 6 in. under the cylinders and to a point 30 in. back from the front end of the casting. Unit steel cradle castings are spliced to the rear of the main frames, the joint being of the same type used on all of the other designs which are fitted with trailer frames.

The cylinders, pistons and valves are similar in details to those on practically all of the other locomotives, the valves being of the piston type and 14 in. in diameter. The front and back cylinder heads are interchangeable between this locomotive and others having cylinders 27 in. in diameter, including the heavy Mikado, the light Santa Fe and the heavy Pacific types. The cylinder and valve chamber bushings, valve bull rings and packing rings, piston bull ring and packing rings and crosshead shoes are all of Hunt-Spiller gun iron.

The main and side rods differ in no essential from those on any of the other locomotives. The side rods are of slab section, this being the rule the only exceptions to which are

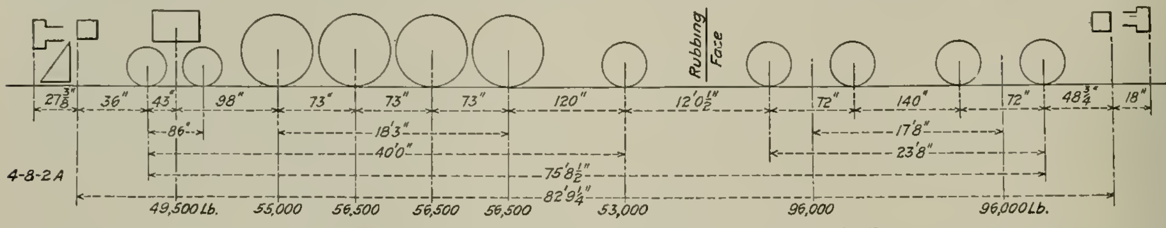


The Railroad Administration Standard 10,000-Gal. Tender Tank

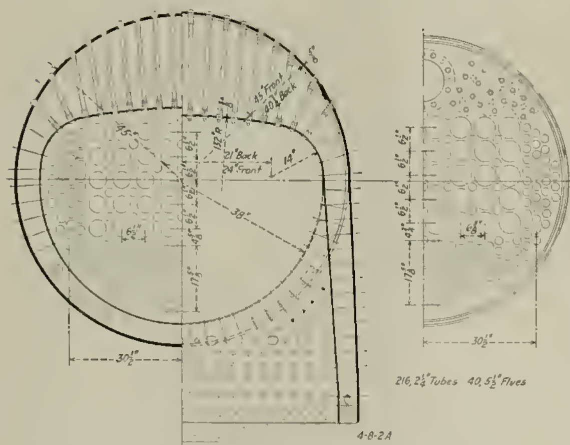
set on the third course. The firebox includes a combustion chamber extending forward 60 in. from the throat sheet, leaving for the tubes a length of 20 ft. 6 in. There are 216, 2¼-in. tubes and 40, 5½-in. flues for the elements of the in the case of the two Pacific type locomotives, which have I-section side rods. There is a considerable degree of interchangeability in the side and main rod bearings between the various classes of standard locomotives. The back end main rod brasses of the light Mountain type interchange with those of the heavy Mikado, light Santa Fe and heavy Pacific types, while the front end main rod brasses interchange with both Mikado type locomotives, the eight-wheel switcher, the light Santa Fe and both Pacific types. Similar, although not exactly the same interchangeability applies to the side rod bearings.

Driving boxes and axles are also of interchangeable design to a very considerable degree. The journal sizes on the front, intermediate and back pairs of drivers of the light Mountain type are 10 in. in diameter by 13 in. in length. With the exception of the main journals, those of the light Pacific, both Mikado types and both Santa Fe types have the same size and both axles and driving boxes interchange. The main journals of the light and heavy Mountain, heavy Mikado, heavy Pacific and light Santa Fe types are interchangeable.

The tenders have Commonwealth unit frame castings and are carried on Commonwealth equalized four-wheel trucks.



The Distribution of Wheel Loads for the Standard Light Mountain Type



Half Sections and Tube Sheet Layout of the Light Mountain Type Boiler

The tank has a capacity of 10,000 gallons, carries 16 tons of coal and is fitted with the Locomotive Stoker Company's coal pusher. The tanks are built up of ¼-in. and 5/16-in. plate with 2½-in. by 2½-in. by ⅜-in. angles at the corners, for the attachment of the splash plates and for the crossties. Two T-irons of 4-in. by 3-in. by ⅜-in. section are used as horizontal stiffeners on each side of the water space and to these the ends of the crossties are attached. The cistern opening has a length of 96 in. across the tank and a width of 18 in.

The clearance diagram and wheel loading diagrams which are included were prepared by F. P. Pfahler, chief mechanical engineer of the Division of Operation, of the Railroad Administration. Actual weights are shown on the wheel loading diagram. The tonnage rating diagram was prepared and is copyrighted by H. S. Vincent. The curves of hauling capacity are constructed for a car resistance of four pounds per ton. The chart may be used for any other car resistance or for any combination of resistances by converting them into terms of grade.

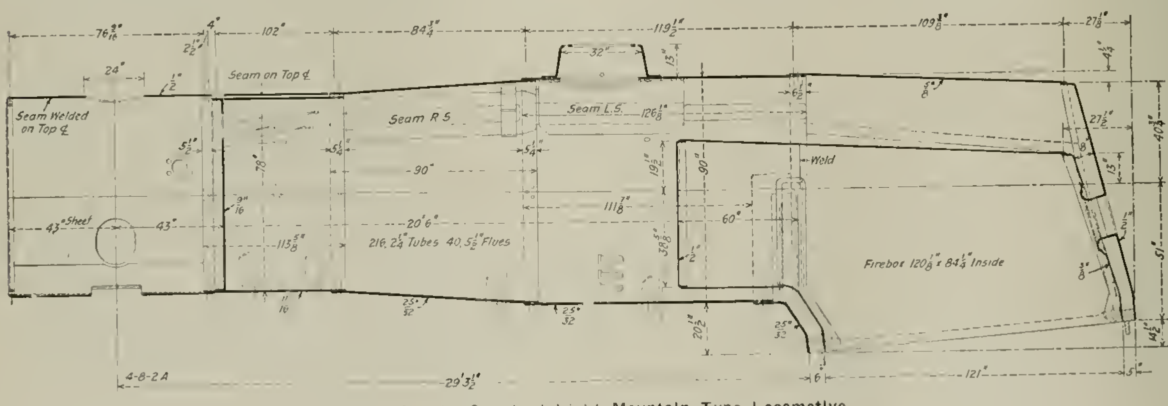
1 lb. car resistance = .05 per cent grade
1 deg. curve uncompensated = .04 per cent grade

For example, find the tonnage which can be hauled in passenger service on 0.5 per cent grade combined with a five degree uncompensated curve at 40 m. p. h. The resistance of passenger coaches at 40 m. p. h. is 6.65 lb. per ton.* The equivalent grade is then:

$$0.5 + (5 \times .04) + (2.65 \times .05) = 0.8325 \text{ per cent.}$$

At the intersection of the ordinate for 0.8325 per cent grade with the drawbar pull curve for 40 m. p. h., we find 800 tons as the capacity of the locomotive.

A list of the specialties on all of the standard locomotives



Boiler for the Standard Light Mountain Type Locomotive

*See the *Railway Mechanical Engineer* for November, 1918, page 607, for a table of passenger cars resistances for use with these charts.

was published in the March issue of the *Railway Mechanical Engineer*, p. 137. The principal dimensions and data for the light Mountain type locomotive are as follows:

General Data

Gage	4 ft. 8½ in.
Service	Passenger
Fuel	Bit. coal
Tractive effort	53,900 lb.
Weight in working order	327,000 lb.
Weight on drivers	224,500 lb.
Weight on leading truck	49,500 lb.
Weight on trailing truck	53,000 lb.
Weight of engine and tender in working order	519,000 lb.
Wheel base, driving	18 ft. 3 in.
Wheel base, total	40 ft. 0 in.
Wheel base, engine and tender	75 ft. 8½ in.

Ratios

Weight on drivers ÷ tractive effort	4.2
Total weight ÷ tractive effort	6.1
Tractive effort × diam. drivers ÷ equivalent heating surface*	667.7
Equivalent heating surface* ÷ grate area	79.2
Firebox heating surface ÷ equivalent heating surface,* per cent	6.2
Weight on drivers ÷ equivalent heating surface*	40.3
Total weight ÷ equivalent heating surface*	58.7
Volume both cylinders	19.9 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	279.9
Grate area ÷ vol. cylinders	3.5

Cylinders

Kind	Simple
Diameter and stroke	27 in. by 30 in.

Valves

Kind	Piston
Diameter	14 in.
Greatest travel	7 in.
Steam	1¼ in.
Exhaust clearance	3/16 in.
Lead	¼ in.

Wheels

Driving diameter over tires	69 in.
Driving journals, main, diameter and length	12 in. by 13 in.
Driving journals, others, diameter and length	10 in. by 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.
Trailing truck, journals	9 in. by 14 in.

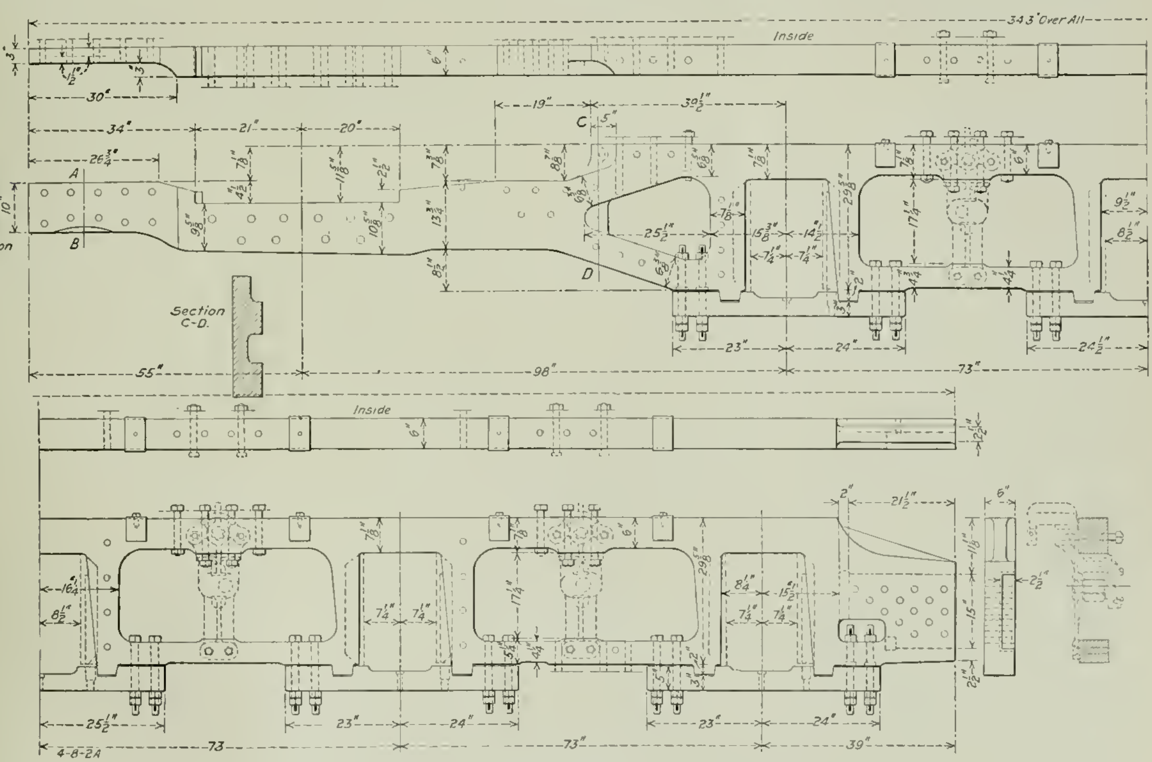
Boiler

Style	Con. wag. top
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	78 in.
Tubes, number and outside diameter	216—2¼ in.
Firebox, length and width	120⅛ in. by 84¼ in.
Firebox plates, thickness	Tube and throat, ½ in.; others, ⅜ in.
Firebox, water space	Front, 6 in.; others, 5 in.
Flues, number and outside diameter	40—5½ in.
Tubes and flues, length	20 ft. 6 in.
Heating surface, tubes	2,597 sq. ft.
Heating surface, flues	1,176 sq. ft.
Heating surface, firebox, including arch tubes	348 sq. ft.
Heating surface, total	4,121 sq. ft.
Superheater heating surface	966 sq. ft.
Equivalent heating surface*	5,570 sq. ft.
Grate area	703 sq. ft.

Tender

Tank	Water bottom
Frame	Cast steel
Weight	192,000 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.



The Frame of the U. S. R. A. Standard Light 4-6-2 Type Locomotive

STORAGE OF COAL BY RAILROADS DURING 1918*

BY H. H. STOEK

Professor of Mining Engineering, University of Illinois

About two years ago the writer sent out a questionnaire to several hundred parties storing coal in quantities varying from a few tons stored in the ordinary house-cellar to hundreds of thousands of tons as stored on the docks along the Great Lakes and by some of the large industrial concerns. The replies to this questionnaire were studied and a tentative set of conclusions drawn up, and sent to the parties who had answered the original questionnarie, with the request that they be thoroughly criticized. As a result of these criticisms, a revised set of conclusions was drawn up and published in Circular 6 of the Engineering Experiment Station of the University of Illinois.

Realizing that during the period of the war the conditions under which coal was stored were unusual, because of the pooling of coal and because the coal furnished was dirtier

*Abstract of a paper presented at the convention of the International Railway Fuel Association at Chicago, May 19-22, 1919.

and less carefully sized than under normal conditions, another questionnaire was sent out during the fall of 1918 to practically the same list of persons as the previous one, asking for the experiences of those who had stored coal during the year 1918 and for a criticism of the conclusions published in Circular 6. A similar questionnaire was sent to a large number of power plants in the state of Illinois, and a large number of fires in coal piles were studied during the summer and fall of 1918. In these several studies, railroad storage was only one of the problems included and furthermore, the study had particular reference to Illinois and Middle West coals.

On March 11 a conference was held in Chicago, at which the general subject of railroad storage was discussed and the general conclusions in Circular 6 were endorsed. Each one was asked to furnish the writer his own conclusions upon railroad storage and copies of all instructions issued by railroads in his territory to be studied and summarized by a sub-committee consisting of Messrs. McAuliffe, Roesch, Collett, Hardy and the writer, at a meeting held in Urbana, March 25. At that meeting certain general conclusions were drawn up as representing what in the opinion of the committee represents safe practice at the present time and these preliminary conclusions were issued by Mr. McAuliffe in a circular addressed to the railroads of the country as a guide to them in storing coal during 1919.

Why Should Railroads Store Coal?—The insurance feature of coal storage is so self-evident as not to need discussion, and the equalization of equipment throughout the year has been fully discussed in the reports of the several coal storage committees. (See also Railway Administration circular.)

Coal stored in summer costs less to transport than would the same amount hauled during the winter. By relieving the roads of transportation cost, general traffic is helped.

Other reasons for storing coal by the producer or by the consumer need not be considered here, as the railroad is a transporting agent only.

The railroads are also interested in the storage of coal, because they are the largest users of it, using more than 25 per cent of the total output for their own uses, and since the transportation of the coal output forms about 34 per cent of the freight carried by the railroads of the United States, the railroads should, therefore, not only protect their own interests by storing coal, but should encourage both the mine operators and consumers to store coal so as to help stabilize the coal industry in order that it can be conducted more nearly up to its full time efficiency and thus decrease the present excessive but absolutely necessary overhead charge due to the fact that the miners of the country work only about 200 days per year.

Suggestions Regarding Storage of Coal by Railroads.—The replies to the questionnaire sent out in 1918 asking for experiences in storing coal during 1918 and for a criticism of the conclusions published in Circular 6, show that the experience of the past year has confirmed these conclusions* in very great part.

Summarizing these suggestions:

Each railroad should study its own storage problem in great detail. Get ready to store before it is time to begin actual storing by outlining a definite policy far enough in advance so that every one who will have to do with the storing can receive *definite* instructions, not merely suggestions. Then when storing begins, see that the instructions are carried out to the letter. Many failures have been due not to faulty instructions from the head office but to the fact that they have not been followed.

When it is time to store, prepare a place carefully. Do not wait until the coal to be stored is on the track and then dump it anywhere to get it out of the cars. Specify the kind of coal that is to be stored and see that the specifications are carried out by having an inspector at each storage pile who is competent, not only to inspect the coal furnished and reject it if not according to specifications, but who has authority to see that the storage instructions are carried out to the letter.

Prepare definite instructions as to the sizes of piles for different coals and for the different kinds of storage appliances that may be available.

Watch the stored coal carefully for any evidence of heating and if the temperature rises sufficiently, begin to move it in time. See that adequate machinery for handling the coal is available and always in condition to be used. Do not store coal unless you are prepared to do it properly and to watch it thoroughly after it has been stored.

Attention to these details will very largely prevent heating of coal or if heating occurs will prevent loss from fires.

It should be understood that each coal storage is a distinct proposition and while it is believed that the suggestions in this paper will be helpful to any one wishing to store coal, they are suggestions and guides only. They are not absolute facts and subsequent experience may show changes to be advisable.

Effect of Storage Upon the Properties of Coal.—The heating value of coal as expressed in B. t. u. has been shown by experiments of the United States Bureau of Mines and by Professor S. W. Parr of the University of Illinois, to be very little decreased by storage. It must be admitted, however, that the opinion is very wide-spread that storage coal burns less freely than fresh coal. This opinion is by no means universal amongst railroad men, for it is distinctly stated by some that the storage coal burns better than the fresh coal.

Experiments at the University of Illinois have indicated that coal that has been in storage can be burned as readily as fresh coal if a thinner bed is kept on the grate and the draft properly regulated. This, of course, applies particularly to stationary plants.

Insurance Adjustments.—An attempt has been made to obtain information regarding the adjustment of insurance in connection with the storage of coal but very incomplete information had been received at the time of writing. It is suggested that this subject is worthy of much more careful and extended study, possibly by a subcommittee of the Fuel Association.

STORAGE SYSTEMS

Choice of a Storage System.—In the choice of a storage system, the following points should be considered:

(1) The location, size, and topography of the available storage ground.

(2) The capacity of the desired installation, that is, the amount of coal which it is desired to load and unload in a given time.

(3) The cost of the plant.

(4) The cost of maintenance.

(5) The cost of operation.

(6) The amount of breakage to be permitted in handling the coal.

(7) The way in which the coal is received, in open or box cars, or in boats.

(8) The length of time the coal must be kept in storage.

(9) Climate: A dry climate with cold nights such as is found in Colorado, for instance, may give different conditions than will be found in Illinois, where there is a great deal of moisture in the air and the summer nights are almost as hot as the days.

The requirements of an ideal plant are:

*The conclusions included detailed instructions regarding the storage of coal as regards location of piles, season when coal should be stored, kinds and sizes which may safely be stored, methods of piling, ventilation and precautions to be taken to avoid spontaneous combustion.

(1) Adequate ground area, so that different kinds of coal may be stored separately if necessary.

(2) Adequate facilities for rapidly and economically transferring coal from cars or from boats into the storage piles.

(3) Adequate facilities for rapidly and economically reclaiming the coal and for rapidly moving any part of the pile which shows evidences of taking fire.

(4) Adequate track facilities, with gravity facilities, if possible, for handling cars.

(5) Means for preventing undue breakage in handling.

(6) Adequate available water supply.

(7) Low cost of installation, maintenance, and operation per ton of capacity. A storage plant is in operation very irregularly and costs are likely to be correspondingly higher because of the heavy fixed charges.

(The paper gave detailed analyses of the advantages and disadvantages of methods of storage particularly applicable to railroad conditions. Replies to questionnaires summarizing current practice and opinion were also included.)

Limit Of Wear For Steel Wheels

Tests Show Flanges of Wheels Worn Below the Present Condemning Limit Have Adequate Strength

A TEST was recently conducted by the testing department of one of the large railroads to determine by comparison with worn cast iron wheels whether or not rolled steel wheels, worn 1/4 in. below the present scrap wearing limit, can be used with safety. To make this test

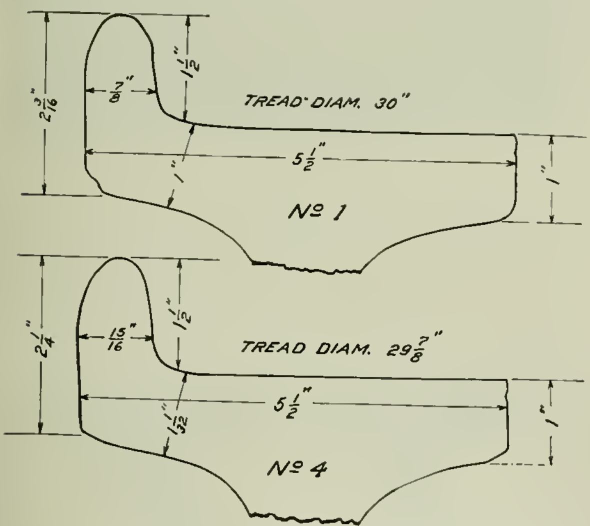


Fig 1—Cross Section and Contour of Wheels to Present Scrap Wearing Limit

four rolled steel wheels were selected from a lot of scrap wheels. The wheels had been in service under locomotive tenders and had treads worn from 2 3/8 in. to 2 1/2 in. below the new diameter, about 1/4 in. above the limit marks. They were rolled in 1917 from three different heats.

The treads of wheels numbered 1 and 4 were turned to a thickness of 1 in. or to the present scrap wearing limit. All flanges were turned to the minimum allowable thickness of 15/16 in. and with vertical surfaces and sharp fillets similar to the worn condition developed in service. Cross sections of the treads and flanges are shown in Fig. 1 and Fig. 2.

In order to make a comparison with worn cast iron wheels, three wheels were selected for test from among the scrap wheels at a large wheel foundry. These wheels were cast at three different foundries the weight and dimensions being as follows:

Wheel number	44 997	2,328	158,891
Date cast	May 27-16	Sept. 16-07	Aug. 14-14
Stenciled weight	740 lb.	700 lb.	625 lb.
Flange thickness	13/16 in.	1 in.	1 in.
Tread diameter	32 13/16 in.	32 3/4 in.	32 11/16 in.

DROP TESTS

The M. C. B. drop test machine at the wheel foundry was used for the tests. The wheels were supported in a way that caused the entire thrust to be taken by the flange. The three steel blocks on which the flange rested were rounded off so as to eliminate any cutting action against the flange, and to confine the supported area to the vertical surface above the fillet. These blocks were supported on three 5-in. anvil blocks, which are the standard equipment of the machine. An iron band surrounding the wheel and blocks

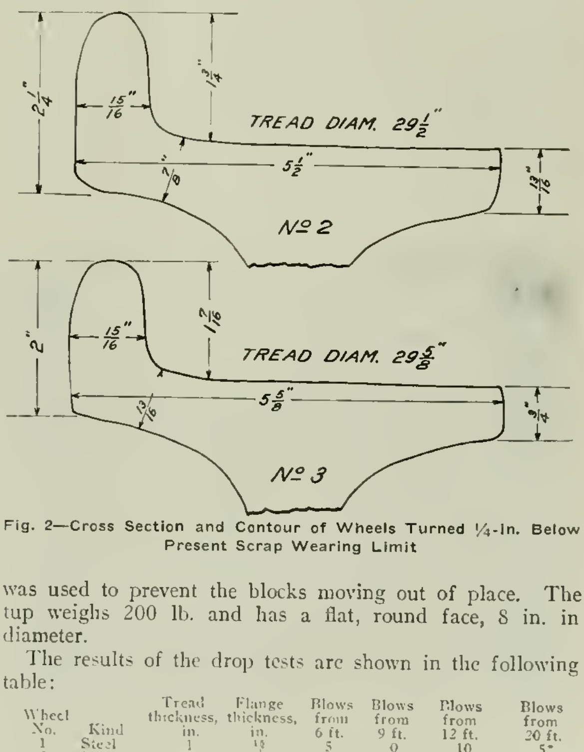


Fig. 2—Cross Section and Contour of Wheels Turned 1/4-In. Below Present Scrap Wearing Limit

was used to prevent the blocks moving out of place. The tup weighs 200 lb. and has a flat, round face, 8 in. in diameter.

The results of the drop tests are shown in the following table:

Wheel No.	Kind	Tread thickness, in.	Flange thickness, in.	Blows from 6 ft.	Blows from 9 ft.	Blows from 12 ft.	Blows from 20 ft.
1	Steel	1	15/16	5	0	10	5*
2	Steel	3/4	15/16	12	2	10	15
3	Steel	3/4	15/16	5	0	10	30
4	Steel	1	15/16	5	0	10	9†
44,997	Cast iron	..	13/16	..	..	1†	..
2,328	Cast iron	..	1	3†	..	..	..
158,891	Cast iron	..	1	1†	..	..	..

*Plate cracked after two blows. Flange not broken.
†Flange broken off.

Typical fractures developed under the drop test are shown in Fig. 3 and Fig. 4. None of the fractures showed any imperfections or irregularities in the metal structure. Wheel No. 1 developed only a slight elongation of the crack through the plate after it had received three additional blows from a height of 20 ft.

STATIC TESTS OF ONE INCH SECTIONS

Sections one inch thick were cut from each of the steel wheels and tested in a Riehle testing machine in a manner which is shown, with the plate removed, in Fig. 5. This arrangement provides a loading, which produces a thrust

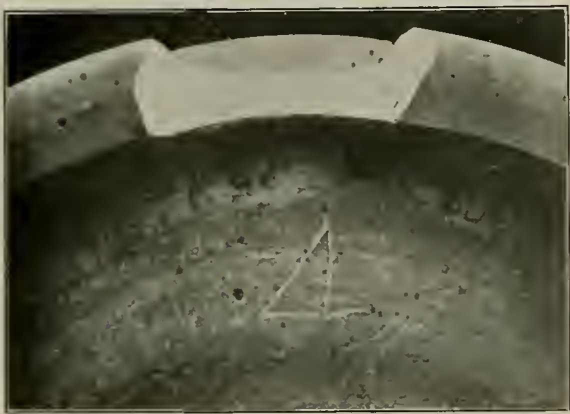


Fig. 3—Failure of Steel Wheel No. 4

in a direction parallel to the axis of the wheel similar to that which occurs in service. A clearance was cut in the lower end of the ram, causing the load to be applied the same distance from the tread in each case.

The results of these tests are as follows: Specimens from wheels numbered 1 and 4, whose treads had been turned to the present scrap wearing limit, broke under loads of 40,450 lb. and 34,720 lb. respectively. Specimens from wheels numbered 2 and 3, whose treads were turned 1/4 in. below the present scrap wearing limit, broke under loads of 22,540

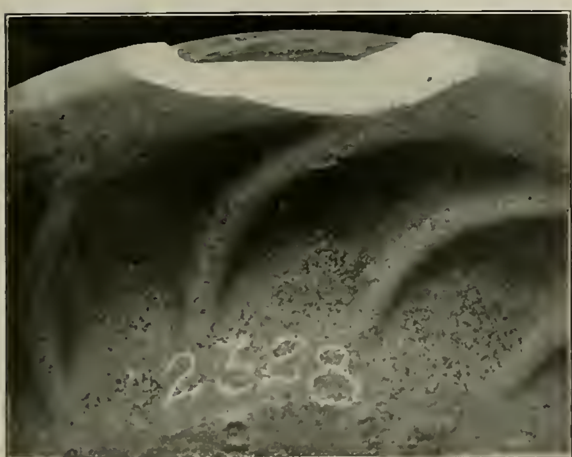


Fig. 4—Failure of Cast Iron Wheel No. 2328

lb. and 24,900 lb. respectively. The character of the failures are shown in Fig. 6.

CONCLUSIONS

The results showed a decided superiority of steel over cast iron wheels under the drop test. Of the three cast iron wheels tested, the best showing was made by the one which had the flange broken off after three blows of a 200-lb. tup from a height of 6 ft., whereas the only steel wheel whose flange was broken, failed after nine blows from 20 ft. Fifteen and thirty blows from 20 ft. caused no failure of the two steel wheels which were turned below the present limit.

These results indicate that a reduction of the thickness of the tread does not affect the strength of the flange in rolled steel wheels.

The failures of the 1-in. sections were similar, in that all broke in the same way at about the same place. In no case did the break occur at the throat of the flange or at the

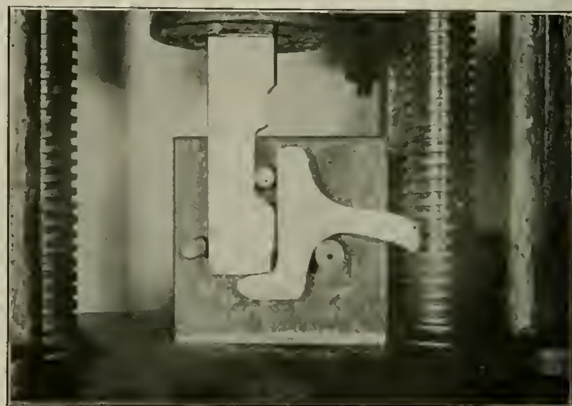


Fig. 5—Manner of Applying Load in Test of 1-in. Sections

thinnest section of the tread, but to one side of the thinnest section, toward the center of the tread.

The results of the drop tests indicate that the rolled steel wheels with treads turned 1/4 in. below the present scrap wearing limit and flanges of the minimum allowable thick-

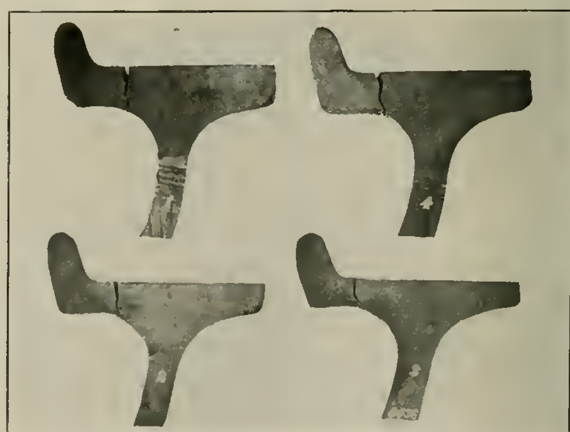


Fig. 6—Failures of 1-in. Sections Taken From Steel Wheels.

ness, have decidedly stronger flanges than cast iron wheels the flanges of which are worn to the minimum allowable thickness.

The nature and similarity of the failures of the 1-in. sections indicate that there is no weakening effect on the flange proper, caused by reducing the tread thickness. There is, however, a weakening of the tread due to its own reduced section.

Master Boiler Makers' Convention

Reports and Discussion; Brick Arches, Ash Pans, Threading of Radial Stays, and Other Subjects

A PARTIAL report of the proceedings of the convention of the Master Boiler Makers' Association, held in Chicago May 26 to 29, was given in the June issue of the *Railway Mechanical Engineer*, which also contained a list of the newly elected officers of the association. In addition to the addresses and papers given in the June issue, other reports of committees were offered to the convention and discussed by the members.

APPLICATION OF BRICK ARCHES

The minimum distance between the grates and the lower part of the arch at the throat sheet for different classes of locomotves depends upon the local conditions; that is, the grade of coal being used, whether it fills up badly or not; and whether the firemen have been taught to shake grates and keep the fire worked down. There are a great many engines which have eight inches as a minimum distance between the grates and the lower part of the arch, and the railroads are getting along very successfully with it.

The proper distance from the door sheet to the top of the brick arch and from the crown sheet to the top of the brick arch for various classes of locomotives is also a local condition. Arches have been run in a great many cases as close to the crown sheet at 11 in. with good results, but some railroads insist that the arch shall not be closer than 16 to 18 in. The distance from the door sheet to the top of the arch is a distance varying greatly, depending upon the length of the firebox. The arch should be run as long as possible in all cases and the top of the arch should be up higher than the top of the door.

The report was signed by L. M. Stewart (A. C. L.), chairman.

An individual report on this subject was submitted by E. W. Young, general boiler inspector, C. M. & St. P., an abstract of which is given below.

It is impossible to set any figure for the minimum distance between grates and the lower part of arch tubes for different classes of locomotives, as so many variables must be taken into account. The distance from the grates to the lower part of the arch tube may be less with a throat sheet that sets back at an angle from the vertical than for a throat sheet which is vertical. It may be less where the grate is flat, than where there is a steep pitch of the front end of the grate, or it may be less in a short firebox than in a long firebox.

The distance from the grates to the lower part of the arch tube may be less in a compound locomotive with its mild draft than in a simple locomotive with its sharp draft. It may be less with one grade of coal than with some other grade.

On account of the variable conditions, it is impossible to set any figure. A good rule and a simple one may be stated as follows: Locate the arch tubes as high above the grates as the design of the firebox will permit. In some cases the arch tubes have had to be located as near as 8 in. to the grate, and yet satisfactory results have been accomplished; however, better results will be obtained if the throat sheet be such that the distance of 18 in. can be obtained between the grates and the arch tubes. The proper distance from the door sheet to the brick arch in various classes of locomotives is just as difficult to determine as it is to answer the first question. One answer might be stated as follows: The brick arch should approach the door sheet as near as possible without restricting the area between the arch and the door sheet, to a figure below the gas area through the flues. It is very seldom, however, that we find a case where the arch can be run as close to the door sheet as the above rule would dictate, due to the fact that under such a condition the gas area between the arch and the crown sheet is unduly restricted. It might be stated that an arch may be built back to within 24 in. of the door sheet, provided conditions other than the relation of the arch to the door sheet will permit.

A good rule in connection with arch designs is that an arch should be as long as conditions will permit, and it is usually the case that these conditions must be studied from two or three angles before we can decide just what the length of the arch shall be, or what the distance shall be between the arch and the door sheet. It would be very much easier to get an ideal arch if the arch were first designed and then the firebox built around it. If the latter condition existed, it would be very easy to answer the two questions, and they would read about as follows: The grates should be placed 18 in. below the front end of the arch tubes. The door sheet should be placed about 24 in. from the back end of the arch. It should be understood, however, that the above two specifications can rarely be made use of for the very reason that arches are built into fireboxes instead of fireboxes built around arches.

Arch tubes must be so located in the flue sheet that there will be access to the front end of the arch tube through the waterleg. In order to get this access through the waterleg, and through a plug hole in the outside throat sheet, arch tube locations are often found to be impracticably low and in such instances a special spacer block is used to elevate the front course of arch brick, so that practical firing clearance is obtained.

The distances discussed above as found on the different types of locomotives used on the Chicago, Milwaukee & St. Paul, and also on the United States Standard locomotives, are shown in the following table:

Chicago, Milwaukee & St. Paul Railway

Type	Distance between grates and lower part of arch tube, inches	Distance from door sheet to brick arch, inches
1-5	13½	45½
G-4	18	37
A-1	16	49
A-2 Straight top	13½	53½
A-2 Slope top	14	44½
B-4 Wide firebox	14½	64½
B-4 Narrow firebox	11½	67
G-6	13	46
K-1	24	59
L-2	23½	49
U. S. Standard Locomotives		
0- 6-0	10	28
0- 8-0	10	37
4- 6-2-A	13	53
4- 6-2-B	15	47
2- 6-2-A	13½	52
2- 8-2-B	15	47
4- 8-2-A	15	46
4- 8-2-B	15	42
2-10-2-A	14½	42
2-10-2-B	15	59

The use of syphons in the place of arch tubes will, in very many cases, permit of considerably better firing clearance than can be obtained where arch tubes are used. There may be many cases of firebox construction, in which an arch on syphons will be practical, while arches on arch tubes would be impracticable. Syphons make a good foundation for a brick arch, and on account of being so substantial they make a practical device to take the place of arch tubes.

DISCUSSION

The discussion developed the fact that there was considerable difference of opinion regarding the proper location of the arch. The point was brought out, however, that it is largely governed by local conditions. It is considered necessary to have the area between the arch and the crown or door sheet from 10 to 25 per cent greater than the area through the tubes.

DESIGN OF ASH PAN AND DRAFT APPLIANCES

Your committee has failed to discover a recognized rule for designing ash pans. The result of our investigations indicates that methods are largely the result of experiments which have developed designs which seem best suited to the type of locomotive and condition of service. The objective to be attained was a self-cleaning arrangement of sufficient storage capacity to prevent the necessity of dumping the ashes except at regular ash pan cleaning points; and to prevent the cinders from burning and warping the pan. The lower parts are designed to be practically air tight, air for draft being admitted at the upper parts only. Ash pan air inlets of eight classes of locomotives averaged 14 per cent of the grate area which, from information obtainable, seems to be about the average air opening in ash pans for coal burning engines.

With the modern wide firebox, pans are made wide at the top, projecting several inches beyond the mud ring with vertical sides to prevent sparks from falling or being blown out by side winds. These upper plates are sloped toward the hopper or storage part so that cinders will slide to the hopper. There seems to be a tendency to sacrifice this slope to obtain greater draft opening, which has resulted in some instances in the cinders piling up on the wings and shutting off the draft, as well as causing stuck grates and burned grates and connecting bars. Therefore the slope from the hopper to the edge of the pan should be not less than 30 degrees and rather than lose this slope, it is better policy, if possible, to get increased opening from back or front.

When locomotives are being designed, the ash pan should be considered and provided for as an important part of the machine, and not as something to be hung on after the locomotive has been set up. The modern ash pan is expensive to construct and still more expensive to maintain, and the greatest possibility of improvement seems to be in the designers who may find it practicable to change the frame lines or other parts sufficiently to give relief where it is greatly needed.

MAINTENANCE OF ASH PAN

Slides, hoppers and dumps should be maintained in an operative condition. Grates should be maintained in first-class condition. Broken, burned or warped grates should not be allowed in service. One bad grate often causes damage to a whole section and also causes waste of fuel and damage to the ash pan.

No air openings should be allowed in the ash pans except those provided for in the design. This is particularly important in the case of oil burning locomotive draft pans, for the reason that air leaks permitted at other points than those designed usually result in brick work troubles as well as interfering with the proper steaming of the locomotive.

Air leaks at the lower parts of coal burning locomotive ash pans are extremely undesirable and annoying, not only on account of burning and warping the plates of the ash pan, but particularly on account of sparks dropping and causing fires along the right of way. It is a mooted point whether fires set from locomotives are not more frequently from the pans rather than from the stack.

FRONT END DRAFT APPLIANCES

The method of determining the design of front end draft appliances has, no doubt, as its basic principle, what was known as the Master Mechanics' front end, and like other parts, constant experiments and experience develop a type of front or setting to suit the conditions.

All parts of ash pan and front end appliances should be carefully fitted and securely bolted in place so that there is no reasonable probability of any part becoming displaced, and should be maintained at all times in first-class condition, each part performing its full function strictly in accordance with the design, particularly draft openings and passages which govern the flow of air and gases through the firebox flues and smoke arch. Dampers which are designed to be operated should be maintained in an operative condition and air admitted only at such points as the drawings provide for. Draft passages should be maintained so that all the draft will pass through those channels, which is not the case if loose or poor fitting plates are allowed. Draft appliances, which include deflecting plates, nozzle, petticoat pipe and stack, may be designed and adjusted to thoroughly clean cinders from front ends, and because plates were not well fitted, leaks direct to the stack may be sufficient to defeat the object of the design, causing cinders to accumulate in the front end, sometimes resulting in burning and warping front end rings and doors and overheating the lower joints of exhaust and steam pipes and developing leaks at those parts.

FRONT END LEAKS

The committee is of the opinion that positively no air leaks should be permitted and that where front ends show indications of burning on account of the combustion of cinders, it is just as often the result of poor fitting plates and air leaks as it is of faulty design or of wrong adjustment of draft appliances. We also incline to the opinion that we should make use of the autogenous welding process to secure permanently to the smoke arch and flue sheet a suitable sheet iron border to which to bolt deflecting plates. This border may be spot welded when being applied or welded in solid. At any rate, it can be an absolutely tight fit, in fact, air tight, if desired. An arrangement of this kind will expedite the work of applying or removing deflecting plates and simplify front end inspection. Petticoat pipes should be maintained to practically a true circle free from holes or indentations, and be securely held in central position between nozzle and stack.

As an item of interest to this association, and to give an idea of the general dimensions of draft openings, the following is given. We find in eight different classes of coal burning locomotives the following comparative dimensions of draft passages:

Eight Coal Burning Locomotives.—Ash pan air inlets equal 14 per cent of grate area, or 39.5 per cent of grate opening, and is 4 per cent more than flue opening area. From this it would appear that pan opening and flue opening are practically the same, while stack area is about 10 per cent of flue opening area.

Seven Oil Burning Locomotives.—These have the same stack opening, flue opening and grate area. They have no grates, but the air inlets through the fire or brick pan, also called the draft pan, are 28 per cent less than the flue opening area, and are 69 per cent, or a little more than twice the stack opening. The comparatively small air openings to the fire in oil burning engines compared to coal may raise the question of whether or not we are allowing too much air to the coal burner, especially with a clean fire. We are of the opinion that the size and location of these openings have been worked out principally by experimental process and, while perfection may not have been attained, when we observe a good steaming oil burner at work one is pretty apt to conclude that there is not much room for improvement.

The effect of proper upkeep of ash pan and front end appliances is to save fuel and maintaining a high standard of condition of those parts saves labor, and effects an economy. Like many other economies not reducible to plain figures, we must accept the above statement because we know that well maintained draft appliances and ash pans do fully perform their functions of furnishing the necessary drafts for economical combustion of the fuel and prevent fires being set out and the destruction and loss of property, which is an important economical consideration. Well fitted and well secured parts of the draft appliances reduce the liability of displacement and failure on account of not steaming and loss of fuel due to poor steaming, and also reduce the necessity of constant changing of front end draft appliances, which is another considerable economy. Finally, well maintained draft applainces may well be considered the difference between a satisfactory, efficient locomotive, which everyone appreciates, and a poor steaming inefficient machine that no engineer wants to run.

The report was signed by Geo. Austin (A. T. & S. F.), chairman; E. J. Nicholson (C. & N. W.), F. Beyer (Penn. Lines), H. F. Weldin (Penn..) and H. B. Nelson (Mo. Pac.)

DISCUSSION

Methods of eliminating the leaks around the steam pipe holes in the front ends were discussed at length. The best results were said to be secured by welding a plate around the opening.

One member told of results which had been secured by the use of cast steel ashpans. He submitted an estimate of cost showing the expense of applying and maintaining sheet steel pans for 15 years to be $915, while the corresponding cost of cast steel pans was $214.

BRACING LOCOMOTIVE TENDERS

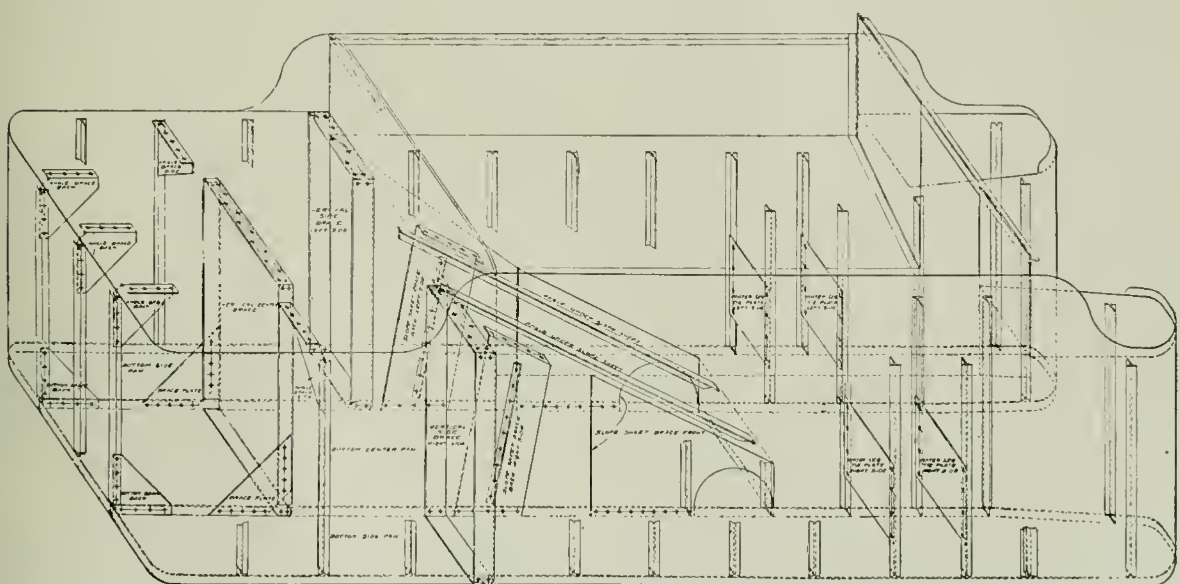
The object of bracing locomotive tenders is to make them sufficiently strong to stand the stresses that take place when the engine is in motion and to prevent the sides and back of the tank from bulging outward. To do this braces are applied on the interior of the tank, and anchor lugs are provided to stop the tank from moving on the tender frame.

What then is the best method of doing this work? Our opinion is the application of T-bars 3 in. by 3 in. by 3/8 in. on sides and back spaced about 24 in. apart in a vertical position, the length of the bars to be equal to the height of the tank from bottom to top, these bars to be riveted with not less than 5/8 in. diameter rivets spaced about six inches apart, zigzag.

The top of the tank at the rear end is braced by the application of T bars riveted to the under side with gusset plates rivetted on the ends. The slope sheet in the coal space is braced by the application of two T bars riveted to the under side, also supported by stay plates placed vertically and riveted to slope sheet and the tank bottom reinforced by angle bars. Dasher or splash plates of 1/4 in. or 5/16 in. thickness are used for the purpose of frustrating the rush of water in the tank; they also form a brace for the top and bottom of the tank. One plate is placed in the center between the coal slope sheet and the back of the tank. Two plates are placed on each side, these are riveted to the top and bottom of the tank. The center dasher plate is flanged on the sides and riveted to the top of the tank, also gusset plates are applied at the bottom and riveted, which gives the dasher plate added strength. In order to make a permanent job all braces used in the construction should be riveted and not bolted.

This method of bracing is recommended for all rectangular tanks made from steel plates of 5/16 in. thickness or less, because it gives better service than the old method of applying longitudinal angle iron bars with cross stays. Also it has the tendency to eliminate leaky rivets in anchor lugs. We are of the opinion that when *weight* is not taken in account when designing locomotive tenders if the tanks were made from heavier material, say steel sheets 3/8 in. thick, it would greatly simplify the matter of bracing as heavier material could be used which no doubt would be more satisfactory. However, with 1/4 in. plates for tank sides and top, and 5/16 in. plates for the bottom of the tank this is the best method of bracing, as it braces the tank in all its principal parts, and still leaves plenty of space on the interior so that the inspector can move around easily to make his inspection or repairs when necessary.

The report was signed by Thomas Lewis (L. V.), chairman; E. J. Sweeney (N. Y. C.), J. J. Orr (D. L. & W.), J. P. Malley (St. L. & S. F.) and J. T. Johnson (A. T. & S. F.).



Recommended Method of Bracing Rectangular Tenders

DISCUSSION

The superiority of vertical over horizontal braces was generally conceded. One of the principal sources of trouble reported was the loosening of the transverse braces. This can only be overcome by good workmanship and by substituting rivets for bolts in these parts.

ACETYLENE WELDING

The committee in presenting this paper realized that this topic has been before the convention for several years and has been thoroughly threshed out by the members. We find it at this time very difficult to write up any new facts on this subject. However, we believe the following information will be beneficial.

APPARATUS

Many shops a few years back were equipped with portable generators, using what is termed "high pressure." Later, new apparatus was installed and shops were piped throughout for the acetylene and oxygen, using low pressure, which at this time is in pretty general use throughout the United States. A number of shops still use the oxygen and acetylene gas furnished in holders with the oxygen holders containing 1,800 to 2,000 lb., and the acetylene holders from 200 to 250 lb. pressure. With this method it is necessary to have different regulators for the oxygen as well as the gas for each wolder. But where the low pressure system is used, it is only necessary to have the regulators where the gas is generated and the oxygen manifolded. It is the opinion of the committee that the low pressure system piped throughout the different departments will give the best results.

WELDING TORCHES .

There are several different makes of welding torches on the market, and while they will all do good work with an experienced operator, some torches are more quickly regulated and do not back-fire as readily as some other makes. In most all cases the welding tips are made of copper and give much better results than the brass.

CUTTING TORCHES

Many different styles of cutting torches are on the market. Some will back-fire readily, where with others it is almost impossible to make them back-fire, and in some cases both with the welding and cutting torches where they do back-fire, can be ignited quickly from the heated iron without readjusting; while, with other makes, it is necessary to shut off and start all over. This causes a loss of time as well as a waste of material.

Different methods are seemingly getting good results. The Chicago, Milwaukee & St. Paul are welding in all side sheets, bolting up securely, and applying stay bolts and rivets before welding. Cross-seams are welded by removing rivets, scarfing down, and welding up all holes and not removing any stay bolts. Door collars, inside and out; three-quarter door sheets, one-half flue sheets, top or bottom; full flue sheets; front sections of crown sheet; bottom patches of front flue sheet, 12 in. to 20 in. high, are all welded and all stay bolts and radial stays are cut off with the torch. In fact, we are doing everything in the line of welding we may find to do, and the sheets we are welding are standing up well and giving us no trouble. The only trouble at times is welding in patches in old side sheets, or where side sheets go to pieces rapidly due to poor water conditions. Where engines are in bad water territory, sheets do bulge between the bolts and at times the weld is pulled in two.

In the different railroad shops on such work as applying fireboxes, side sheets and door sheets, the welding in most cases is being done with the acetylene torch. Shops visited had both the acetylene and electric welding outfits, but were using the electric outfit mostly for welding flues, mud ring corners and roundhouse work, where the portable electric welding outfit will give good results.

Electric welding outfits have been installed for welding in all flues, mud ring corners, side sheets, cutting out the center and welding in new without removing mud ring rivets. It is also planned to do considerable firebox and boiler work with the electric welder, where flanges on front or back flue sheet are still good, cutting out the center and welding in new.

The report was signed by Henry J. Wandberg (C., M. & St. P), chairman; L. M. Stewart (A. C. L.), J. J. Davey (Nor. Pac.), John Harthill (N. Y. C.), P. F. Gallagher (B. & O.), and T. F. Powers (C. & N. W.).

DISCUSSION

The discussion brought out a great diversity of opinion regarding the advisability of welding firebox seams. Some condemned the practice as unsafe, while others contended that with proper care welded seams could be made stronger than riveted seams.

Some roads reported good results from welded tubes, others that the use of this practice had been a failure because of cracks in the bridges of tube sheets. All agreed that experience was essential for the production of satisfactory work. Some roads check the ability of welders by requiring weld specimens regularly each month; these specimens are then broken in a testing machine.

PROPER METHODS OF THREADING RADIAL STAYS AND TAPPING THE HOLES

The theoretical way to thread a radial stay is to make its thread align with the tap with which the holes in the crown and roof sheets are tapped. Experiments have proved that no better results are obtained from this method than where no attention was paid to the alinement. This is due to a slight variation in taps and threading machines and the tendency of the tap when tapping the roof sheet to assume a radial position in relation to roof sheet.

A practical method of tapping the holes is to use a double ended tap. However, good results are obtained with single ended spindle taps. It is very necessary that the tapping and applying of radial stays should have the same consideration as stay bolts in side sheets. The holes should be tapped with a suitable length tap so as to make a continuous thread. Radial bolts should be threaded in a machine equipped with a lead screw. If this is done there will be no trouble with entering bolts in crown sheet, on account of stripped threads.

The report was signed by H. J. Raps (I. C.) chairman and J. J. Keogh (C. R. I. & P.).

DISCUSSION

The threading of holes for radial stays from the outside was considered advisable due to the fact that the hole in the sheet next to the motor was slightly enlarged, and, if on the inside of the fire box it was difficult to make a tight joint. Practically all the members were of the opinion that it was a waste of time to try to get the same lead on the tap and on the stay as the variation in lead could not exceed half a thread or 1/24 in., which was easily compensated by the spring of the sheet.

CUTTING OFF STAYBOLT ENDS

In a shop that is equipped with crane facilities, where boilers are removed from frames and can be turned in any position, nippers can be used to good advantage. However, complaints have frequently been heard that the nippers do not make a good even end to drive, and it is very often necessary to go over the bolts and trim them with a chisel before driving The use of the chisel in cutting off stay ends can hardly be considered, as it will damage the thread on the bolt and in the sheet; it also elongates the holes.

We believe the acetylene is so far superior to this method that there is hardly any room for discussion. In using the oxy-acetylene process the bolts can be cut to a uniform length, with the boiler in any position. It leaves the bolt annealed for driving. In shops that are not provided with crane facilities, for boilers with narrow fireboxes, for cutting off scattered bolts, bolts applied in patches and radial stays, or where the boiler is on the frames and in an upright position and the bolts are applied from the inside, we believe the acetylene has no equal. The difference in cost will depend a great deal on the operator.

The report was signed by W. S. Larason (H. V.) and J. B. Tynan (W. & L. E.).

CO-OPERATIVE RESEARCH AND THE FUEL PROBLEM*

BY CAPTAIN O. S. BEYER, JR., U. S. A.

The influence of such fundamental items of railway operating expense as the cost of fuel and labor on the direction of developments, both mechanical and economical, in the industry has always struck me as a most important subject for consideration. When practices of locomotive and car construction or train operation of America are compared with those of Europe, striking differences are revealed. Intensive studies of the effect of basic cost items indicate more clearly than anything else the reasons why, for instance, the superheater, the mechanical stoker, the brick arch, the feed water heater, as well as the composite modern types of American locomotives themselves, assume tendencies in this country differing quite markedly from analogous tendencies in other countries. In fact, I do not think it an exaggeration to say that the whole course of American railway development is greatly influenced by the cost of fuel and labor. The problems created by the railway labor and fuel situation have a large economic background, which is very fundamental in its relation to the whole transportation industry. An analysis of this phase of the problem is a big subject in itself and cannot be elaborated here. Certain elements of the problem, however, are amenable to certain forms of solution which are becoming more and more important. Briefly, these particular solutions may be characterized as possible methods for increasing the productivity of the agencies creating the operating cost in question. To increase, at it were, the yield of fuel, to get more out of every pound, to utilize it more efficiently, is of more importance today than it ever was, and will become more and more so as each increment added to its cost places an additional premium on its efficient use.

The time has come, in my estimation, to survey the railway fuel situation, its problems and possibilities, with a thoroughness never attempted before. This association has succeeded, after several years of strenuous effort, in effecting a co-operation between many interests, whereby a piece of fuel research was accomplished which undoubtedly some day will be considered the inception of a movement contributing most extensively to the solution of the present-day railway fuel problem.

Since the committee on Fuel Tests handed in its report on the Test of Six Grades of Coal from a Franklin County, Illinois, Mine, at the 1917 convention, much has transpired. We have come to realize, as never before, the true significance of the scientific method in the solution of the problems in our industries, as compared with the slow, dull, expensive practices of cut and dry, rule-of-thumb, or by whatever other term the awkwardness of much of the industrial progress of the past might be characterized. Perhaps no other event of international importance than the war for democracy has served to emphasize this so well. A new realization has developed among scientists, engineers, administrators, statesmen, concerning the value of the *scientific method* in the solution of industrial problems.

It is my intention to point out as far as this association is concerned that its greatest opportunity lies in the direction of continuing and developing as rapidly as possible the lead it took when, through its Committee on Fuel Tests, it brought together the many interests and secured the necessary funds which eventually made possible the report already mentioned. This was but a beginning and a beginning under most adverse circumstances. As all this is indicative of what co-operation in research really means, the question which arises is, what can be done in this direction on behalf of contributing to the solution of the railway fuel problem? The Fuel Conservation Section of the United States Railroad Administration thoroughly appreciates the activities of this association. The extensive fuel and locomotive test facilities, but so meagerly used, at the Illinois, Iowa and Purdue experiment stations need but to be referred to. It seems, therefore, that the whole question reduces itself to one of initiative with the International Railway Fuel Association.

All these remarks would perhaps have little appeal were there not many important railway fuel problems pressing for solution. Consequently, in support of the remarks I have made above, the following fuel investigations, which can only be carried on in a sufficiently comprehensive way by co-operative research, are submitted for consideration by way of conclusion:

(a) *The Chemistry of Combustion.*—The theory of combustion as it exists today, applied to the burning of locomotive fuel, is incomplete, and fails to explain the occurrence of some very important phenomena, especially with reference to fires of varying thicknesses, clinkering, coking, the nature of the higher hydrocarbon products of combustion, etc.

(b) *Firing Practices.*—The purpose of this should be to determine the most economical combination of practice, devices and kinds of fuel in different territories possible. Maximum boiler capacities resulting from these combinations as well as relative smoke production should be determined.

(c) *Heat Absorption.*—A detailed experimental, as well as mathematical study of the process of heat transfer in the locomotive boiler should be made, especially with reference to the distribution of the heating surfaces between tubes, flues, combustion chamber and firebox.

(d) *Chemical and Physical Nature of Exhaust Gases.*—A splendid opportunity exists to investigate the products of combustion as they appear in the locomotive front end after they have done their work. The results might go a long way towards explaining the mysterious "unaccounted for" losses in the heat balance.

(e) *Accurate Smoke Measuring and Indicating Devices.*—Jointly with the foregoing investigation, attempts should be made to develop accurate smoke measuring and indicating devices.

(f) *The Drafting System.*—An investigation of the entire drafting system of the modern locomotive cannot be made too soon. The proportioning of ash pan opening, grate opening, gas areas between the end of the arch and the door sheet, of flues, tubes, and superheater damper, the space under the smoke box diaphragm, and the smokestack should all be carefully determined and general values for them expressed in empirical formulae having a wide range of application. This is far from accomplished today.

(g) *The Law of Resistance to Flow of Gases.*—Detailed study of the flow of gases through the locomotive boiler reveals possibilities for reducing their resistance to flow and perhaps at the same time suggests ways for effecting greater interchange of heat between these gases and the heating surfaces.

(h) *Radiation Losses.*—Very little is known about this important item, and in consequence losses resulting there-

*Abstract of a paper presented before the convention of the International Railway Fuel Association at Chicago, May 19-22, 1919.

from are thrown in with those considered as "unaccounted for." It is entirely possible to develop data on this point, especially with the perfected methods of pyrometry now in existence.

(i) *Locomotive Feed Water Heating.*—After a long period of development, the locomotive feed water heater is at last becoming available. As it stands today, it is perhaps one of the finest examples of the results of scientific experimentation applied to the solution of locomotive problems. The good work, however, should not stop. As long as feed water can be heated to still higher temperatures, as long as there are heat units still going up the stack which might be saved, the feed water heater investigation should continue.

(j) *Locomotive Boiler Performance.*—The whole general subject of locomotive boiler performance needs more study. Unfortunately the available reliable test data covering a sufficient range of performance is entirely too limited for this purpose. Consequently little opportunity exists for developing an extensive and well founded theory for locomotive boiler design.

(k) *Further Study of the Superheater.*—The superheater deserves further investigation. The work done at Purdue and especially at Altoona with varying lengths and diameters of superheater units has certainly contributed most valuable knowledge on this subject. As a continuation of this work the correlation between degree of superheat and boiler pressure as reflected in the steam economy of the engine should be worked out over wider ranges and mathematical determinations verified. Another very important question coming within this field is the effect of varying degrees of moisture in the steam entering the superheater.

(l) *Fuel.*—Investigation concerning fuel should primarily contemplate securing data on the relative steaming values of the fuel used in the railway service as determined from a complete series of boiler performances as well as maximum evaporative capacity tests. The data should also include information on the spark and smoke production of the various coals and their clinkering and honeycombing qualities, in order, if possible, to tie up practical performances of coals with the characteristics indicated by proximate and ultimate analysis and other laboratory tests of selected samples. The fuels which should thus be investigated are: (1), Typical coals from all important mining districts; (2), various commercial sized and some specially sized coals; (3), land stored, water stored and freshly mined coals; (4), powdered bituminous, anthracite, lignite and peat, together with combinations thereof; (5), oil, lignite, anthracite and bituminous coals, coke, peat, briquets and possible mixtures of these fuels.

Complete information as outlined would enable the railroads more clearly to specify desirable and necessary characteristics of fuel and to select fuels with far more intelligence than can now be done. It would enable them to determine with much greater accuracy the actual value of the various fuels available instead of solving this vital question by the unscientific methods now employed of "collective bargaining" between coal salesmen and fuel or purchasing agents. Some tests have been made to determine the relative steaming value of and the maximum capacity obtainable from certain typical locomotive coals and a limited number of different sized coals. One railroad, which has developed this data for coal used on its lines, has effected economies which have paid in one year over tenfold the cost of making the experiments.

It is entirely possible mechanically to prepare fuel in a highly pulverized form and burn it in a locomotive furnace. The machinery for doing this has been devolped and used with success. The next logical step is to determine accurately just what is the complete economic value of the utilization of pulverized fuel. The many general advantages which are bound to follow its use are, of course, recognized, but it is not known how much, for instance, the evaporation per pound of coal is increased at different rates of combustion. The heat balances over the complete range of boiler capacities of a few typical boilers fired with pulverized fuel have yet to be compared with the balances of these same boilers fired with ordinary fuel. And lastly, values as exactly as possible of the increase in capacity of the pulverized fuel fired boiler should be established. It is not yet possible completely and finally to judge the wisdom either of attempting to perfect or of widely introducing this system of combustion.

GAS WELDING SPRING BANDS

The cost per piece is a most important factor in determining the best process of welding when a large number of similar parts are required. For welding spring bands the oxy-acetylene process has given good results at the Rocky Mount shops of the Atlantic Coast Line.

The bands are formed to the required shape with a V-joint at one of the small sides and the welding done as shown in

Welding Spring Bands At Rocky Mount

the illustration. One operator welds five bands per hour at an average cost of 30 cents each for labor and material. Before the oxy-acetylene process was used these bands were welded at the forge, a blacksmith and helper welding two bands per hour at a cost of 57 cents each. A saving of 27 cents per band is thus effected.

Five Years Wandering in the Wilderness.—Pacific Electric box car 2586, which left the builders, American Car & Foundry Company, St. Louis, Mo., December, 1913, arrived on home rails (first appearance) May 18, 1919. It had made seventeen trips between the Middle West and Eastern States, three between Atlantic and Pacific ports, one trip between Colorado and Eastern states and two trips between Eastern states and Texas. On one road it stayed 108 days; another it visited nine times in one month. This is the last to arrive of ninety box cars bought in 1913.—*Pacific Electric Magazine.*

NEW DEVICES

A DEVICE FOR BREAKING IN LOCOMOTIVES

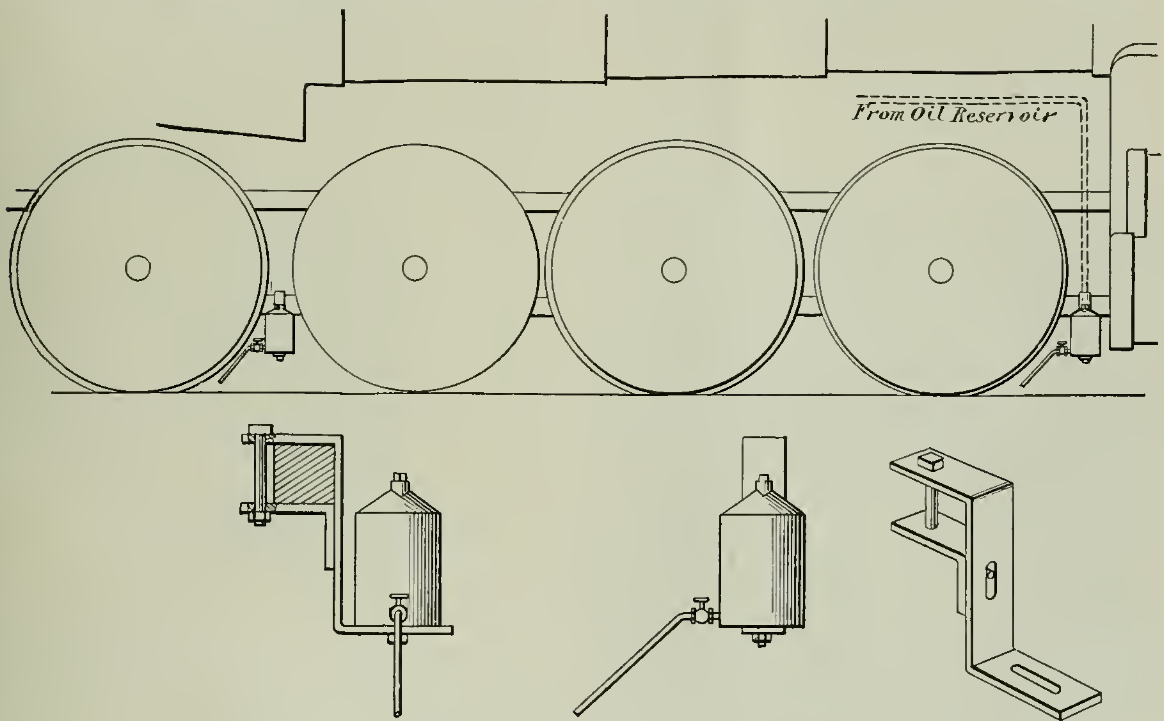
A device designed to permit the breaking in of a new or repaired locomotive on a short length of track near the shop is described in a patent granted to A. C. Hinckley, superintendent of motive power and machinery, of the Oregon Short Line at Pocatello, Idaho. It consists of a bracket attached to the locomotive frame and supporting a small oil reservoir having a discharge pipe extending down close to the rail directly in front of the wheel. The reservoir is filled through a hole in the top, and a valve located in the discharge pipe controls the flow of oil to the rail. When the device is used on oil-burning locomotives it may be connected to the oil tank, thus insuring a constant supply of oil without the necessity of refilling the reservoir.

This device is attached at several or all of the driving wheels and by means of the discharge of oil on the rail, under the wheel tread, causes them to slip and rotate rapidly but, because of the lack of adhesion of the wheel and the rail, the locomotive is moved along the track at a very slow speed.

By its use the driving wheels may be revolved at a speed equivalent to forty miles per hour while the locomotive itself does not move along the rack at more than three or four miles per hour.

This gives the same effect as a break-in trip in service and being near the shop at all times permits immediate adjustment as the operation of the locomotive indicates it may be necessary.

Breaking in and making adjustments at the terminal reduces the probability of engine failure on the road with the consequent delays to traffic.



The Breaking-in Device Attached at the Front and Rear Driving Wheels

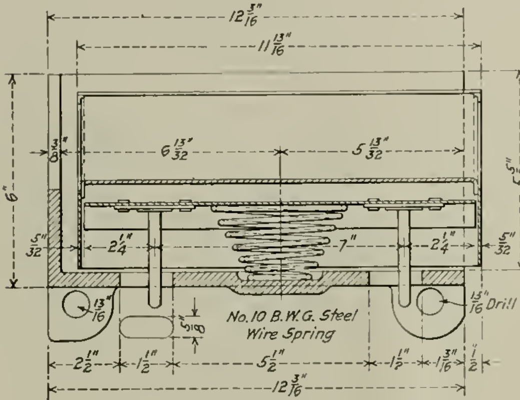
This method of breaking in locomotives is being used at the Pocatello shops of the Oregon Short Line with execelent results.

UTILITY STEAM OR COMPRESSED AIR HAMMER

In an article under this title, which appeared on page 372 of the June issue of the *Railway Mechanical Engineer,* the hammer was incorrectly described as a 30-in. Cincinnati special forge, operated either with compressed air or steam. The hammer should have been described as a general utility forge hammer which uses either compressed air or steam. This hammer is the product of the Sullivan Machinery Company, Chicago, Ill.

GREASE LUBRICATION OF LOCOMOTIVE DRIVING WHEEL HUBS

Excessive lateral motion between driving wheel hubs and driving boxes is a very serious defect as it is costly to repair and necessitates taking the locomotive out of service for a considerable period. The report of the chief inspector of locomotives for 1918 shows that 1,432 locomotives were taken out of service by federal inspectors for this defect alone.



Cross Section of Journal and Hub Lubricator

Despite the expense caused by excessive lateral motion and the fact that heating of the hubs is regarded as a frequent cause of overheated journals, the lubrication of driving wheel hubs is usually left to take care of itself. In order to overcome the objectionable conditions mentioned, a grease lubricator which feeds the lubricant to the hub face as well

Sheet Steel Cellar for Locomotive Driving Box

as the journals has been developed by I. Scranton, Decatur, Ill.

The device consists of two perforated plates, one to fit the journal and the other to bear against the hub liner. The grease rests on a solid plate inside the perforated plates and is supported by a coil spring which sets in a recess in the cellar and holds the plate against the journal and the hub, as shown in the drawing.

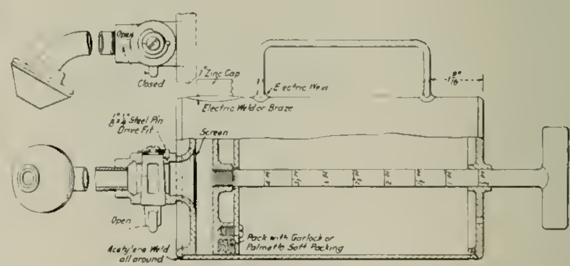
A recent improvement in the construction of the Scranton hub lubricating device consists in the elimination of the cast cellar. Two spreaders are used to form a base for the grease cellar to rest on, these being held in place by the usual cellar bolts. Fastened to the spreaders is a sheet which has a recess in which the supporting spring rests. Doing away with the cast cellar allows the perforated plate to come up higher on the journal, increasing its width 3 in. on a journal 10 in. in diameter and also increases the area of the sheet which lubricates the hub. The use of the spreader eliminates the trouble due to the box closing in on the cellar and facilitates the removal of the cellar. The Scranton hub lubricating device has been applied to several types of locomotives on the Wabash and service tests have shown that it reduces the lateral wear on driving boxes and hubs from 25 to 40 per cent.

A CYLINDER LUBRICATOR FILLER

A practicable lubricator of simple construction is the invention of G. W. Sturmer, a locomotive engineer, of Baltimore, Maryland, to whom a patent covering it has been granted. It consists of a cylindrical container having its interior surface finished to receive a piston which is attached to a rod passing through the cylinder head at one end and having a handle on its outer end. A packing held in place by a follower bolted to the piston gives a close contact to the cylinder walls. A handle is welded to the container body.

The central delivery passage, formed integral with one of the heads, is fitted with a delivery cock having an operating handle. A flexible filling pipe is attached to the outer end of the delivery passage and is provided with a nozzle fitted with a conical washer of compressible material. The supply opening is located in the body wall at the delivery end and can be tightly closed by a removable screw cap.

To operate the filler the piston rod is drawn out, (an atmospheric relief opening in the cylinder head permits this to be done easily), so that the graduations on the rod indicate that the volume of the space between the piston and the delivery cock is sufficient to contain the quantity



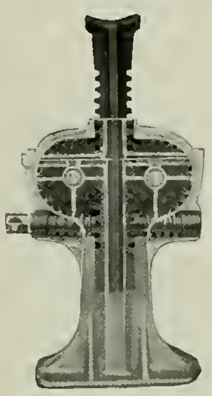
Lubricator Filler With the Delivery Cock Closed

of oil desired. The oil is then poured in through the supply opening, the screw cap replaced and tightened and the nozzle inserted in the filling hole of the lubricator. The piston is then pushed in, thus forcing the oil into the lubricator. A strainer of fine wire gauze placed over the inlet to the delivery passage prevents any foreign matter from entering the lubricator.

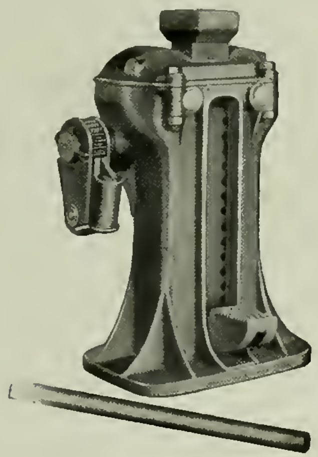
This filler provides an accurate, economical and safe means of filling a lubricator, as the graduations on the piston rod indicate the exact amount of oil delivered. The pressure on the piston, with the close contact of the conical washer at the lubricator, insures a constant flow of oil with a reduction of the waste experienced when filling a lubricator from a can and at the same time protects the operator from steam leakage through the lubricator throttle.

DOUBLE WORM DRIVE LIFTING JACK

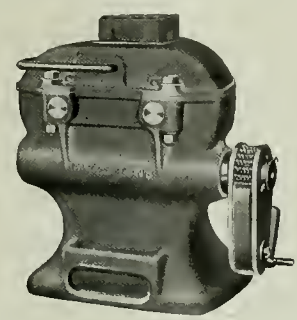
A new type of lifting jack is being manufactured by the Iron City Products Company, Pittsburgh, Pa., which is known as the Rees Double Worm Drive Lifting Jack. Instead of a single worm gear pinioned to a lifting bar the double worm principle is employed. In this design right and left hand worms are cut on the worm shaft, which mesh with right and left hand worm gears carrying heavy pinions. The lifting bar, which has a set of teeth on either side, is located between the pinions and is raised or lowered by the double action of the two gears with extremely small effort and without the loss of power due to the friction that is caused by an unbalanced thrust on the worm shaft and lifting bar.



Cross Section of Rees No. 1 Jack



General Purpose Jack



Car Journal Jack

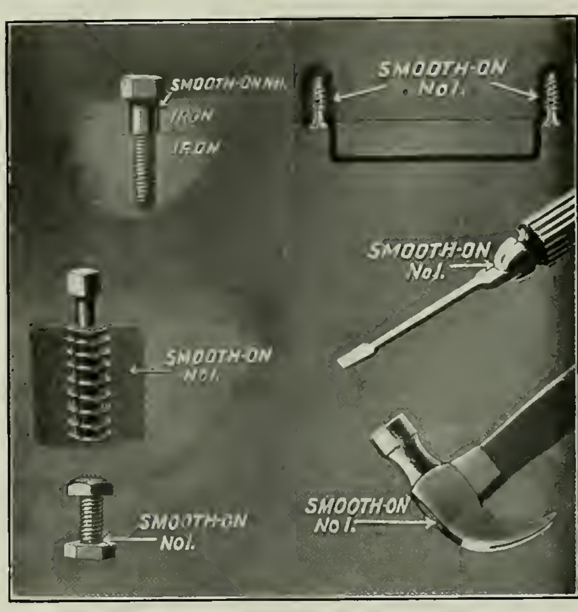
A number of different sizes and capacities of jacks designed with the double worm drive are being made. The car and general purpose jacks are made in a number of different heights and capacities, rating from 10 to 25 tons, while the jack shown in the sectional view is made in three heights, 9 in., 10 in. and 11 in., all having a rated capacity of 25 tons.

The simplicity and strength of construction of these jacks and the small number of working parts adapt them to rough usage, as there are only four working parts and no small parts to get out of order.

HANDY KINKS WITH IRON CEMENT

Some unique uses to which Smooth-On iron cement has been put are described by the Smooth-On Manufacturing Company, of Jersey City, N. J., and are shown in the illustration. This cement expands as it hardens and it is this property which makes it effective for the following applications.

The handles of hammers, which have become cracked and loosened may be strengthened and securely fastened in the tool by the use of Smooth-On. The cement is mixed with water to the consistency of putty and the handle dipped in it until that portion of the handle which enters the tool is covered and all the irregularities and cracks completely filled with cement. The inside surface of the hammer head is then thoroughly covered with cement and the handle pressed in. After wiping off any surplus cement and allowing the cement to harden, the hammer is ready for use. The handles of chisels, files, screw drivers and other tools may be treated in a similar manner.



A Number of Convenient Uses for Iron Cement

A method of securing expansion bolts or screws in concrete or a brick wall is also shown. A hole considerably larger than the bolt or screw is drilled and filled with cement. The bolt or screw is then inserted, twisting it as it is pushed in, and the cement allowed to harden before placing any weight upon it.

As a substitute for a lock nut or a lock washer this cement may be applied as shown in the top and bottom left hand illustrations. The cement must always be allowed to harden before any use is made of the parts so treated.

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WE GUARANTEE, that of this issue 10,000 copies were printed; that of the 10,000 copies 9,000 were mailed to regular paid subscribers, 80 were provided for counter and news company sales, 206 were mailed to advertisers, 27 were mailed to employees and correspondents, and 687 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 62,610, an average of 8,659 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The new shops of the Pullman Company at Ludlow, Ky., were destroyed by fire on the night of May 20, together with six sleeping cars; estimated loss, $225,000.

The new shops of the Canadian National at Leaside, near Toronto, Ont., were opened for business a few weeks ago. The plant consists of a roundhouse, powerhouse, administration building, locomotive repair shop and car repair shop.

The use of heavy guns on railroad cars is engaging the attention of officers of the War Department at Washington in connection with their studies of the defenses of the Chesapeake bay district. Coast artillery officers are now conferring with railroad officers regarding the practicability of constructing permanent spurs from the main lines to the coast around Chesapeake bay. The vicinity of Roanoke, Va., is also being studied in connection with its importance to the defense of the national capitol. Several heavy howitzers and rifles mounted on cars already are available, other units are under construction and still others will be brought back from France.

The Federal Board of Vocational Education has issued a 35-page pamphlet, for the benefit of disabled soldiers, sailors and marines, telling what kinds of work they may be able to find in the field of transportation, including steam railroads, street railways, wagons, automobiles and ocean steamships and harbor craft. The government stands ready to educate and re-educate disabled men, and the educational department in the military and naval hospitals will give inquirers all needed information. This pamphlet is designed to aid individuals in choosing a vocation. It tells what kind of work must be done, and what qualifications are required, in the case of telegraphers, train despatchers, station agents and other station workers, yardmasters, clerks, ticket examiners and traffic department employees; shop work, boiler making, blacksmithing, electrical work and car repairs; track work and train work. The work on electric railways and on ocean and harbor vessels is described in the same way. The Federal Board of Vocational Education, which is ready to give all possible aid to disabled soldiers, has offices in Boston, New York, Philadelphia, Pittsburgh, Baltimore, Washington, Atlanta, New Orleans, Dallas, St. Louis, Cincinnati, Chicago, Detroit, Kansas City, Minneapolis, Denver, San Francisco and Seattle.

MEETINGS AND CONVENTIONS

New York Electrical Society.—Edwin B. Katte, chief engineer of electric traction of the New York Central, has been elected president of the New York Electrical Society. Mr. Katte was graduated from Sibley College, Cornell University, with the degree of M.E. in 1893, and with the degree of M.M.E. in 1894. He began railroad work on the New York Central & Hudson River in 1896. In 1903 he was appointed electrical engineer, which carries with it the secretaryship of the electric traction commission. In 1906 he was appointed chief engineer of electric traction of the New York Central & Hudson River. Mr. Katte is a past vice-president of the American Society of Mechanical Engineers.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Association, Section III—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention, August 27-29, Hotel Sherman, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—H. J. Smith, D. L. & W., Scranton, Pa.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention September 2-5, 1919. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Convention, September 16-19, Hotel Sherman, Chicago.

PERSONAL MENTION

GENERAL

C. I. Evans, chief fuel supervisor of the Missouri, Kansas & Texas of Texas, has been appointed chief assistant mechanical superintendent of the Missouri, Kansas & Texas and associate roads, with office at Denison, Texas, in charge of maintenance of equipment.

H. P. Anderson, mechanical superintendent of the Missouri, Kansas & Texas and the Missouri, Kansas & Texas of Texas, with office at Denison, Texas, has been transferred to the staff of the federal manager at St. Louis, Mo., in charge of executive and administrative matters of the mechanical department on the roads under the jurisdiction of C. N. Whitehead, federal manager, at St. Louis.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

F. S. Kelly, master mechanic of the Louisiana division of the Texas and Pacific, with headquarters at Gouldsboro, La., has been transferred to Marshall, Texas, succeeding R. E. Roe, resigned.

W. L. Robinson, superintendent of fuel and locomotive performance of the Baltimore & Ohio, with headquarters at Cincinnati, Ohio, has been promoted to division master mechanic of the Illinois division, at Washington, Ind.

CAR DEPARTMENT

J. McWood has been appointed master car builder of the Grand Trunk, Eastern Lines, with headquarters at Montreal, Que., succeeding J. Hendry, assigned to other duties.

SHOP AND ENGINEHOUSE

Joseph Chidley, assistant superintendent of motive power of the New York Central, Lines West of Buffalo, at Cleveland, Ohio, has been appointed superintendent of motive power of the Lines West, succeeding D. R. MacBain.

D. R. MacBain, superintendent of motive power of the New York Central, Lines West of Buffalo, has been appointed assistant general manager of the Lines West, with headquarters at Cleveland, Ohio.

Herman F. Noyes, traveling engineer of the Maine Central, has been appointed superintendent of fuel economy of that road and the Portland Terminal, with office at Portland, Maine.

Charles J. Scudder has been appointed superintendent of shops of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., succeeding Joseph Grieser assigned to other duties.

PURCHASING AND STOREKEEPING

W. C. Bower, purchasing agent of the New York Central, with headquarters at New York, has had his jurisdiction extended over the Lines West of Buffalo, succeeding G. R. Ingersoll, who has resigned to engage in other business.

Dwight C. Curtis, inspector of stores on the Chicago, Burlington & Quincy, with headquarters at Chicago, has been promoted to supervisor of stores of the Northwestern region, with the same headquarters, succeeding J. E. Mahaney, resigned to accept service elsewhere.

Horacio V. Garza has been appointed assistant purchasing agent of the National Railways of Mexico, with office at New York, succeeding F. P. de Hoyos, who was local purchasing agent. Mr. de Hoyos remains as general agent of the National Railways of Mexico as well as purchasing and general agent of the Southeastern Lines of Mexico.

SUPPLY TRADE NOTES

R. P. Lamont, president of the American Steel Foundries, Chicago, has authorized the announcement that a contract for the purchase of the Griffin Wheel Company has been signed.

Edward Walters, sales engineer for the American Steel Foundries, Chicago, has resigned to enter the employ of the Keyoke Railway Equipment Company, Chicago, as salesman, with headquarters at Chicago.

H. M. Davison, for the past 14 years connected with the sales organization of the Hayward Company, has left that company to become sales manager of the Ohio Locomotive Crane Company, Bucyrus, Ohio.

George W. Jones, assistant manager of the New York office of the Pittsburgh Steel Company, of Pittsburgh, Pa., has been appointed manager of the Chicago office, with headquarters in the McCormick building.

W. R. Gillies has resigned as mechanical engineer of the Oregon Short Line, with headquarters at Pocatello, Idaho, to enter the employ of the Union Asbestos & Rubber Company, Chicago, as assistant to the president.

The Bordon Company, Warren, Ohio, manufacturers of the Beaver die stocks and die cutters, has opened a downtown Chicago office at 549 West Washington street, in charge of Charles A. Green, Chicago representative.

The Duntley-Dayton Company, Chicago, has taken over the sales agency for the Red Devil rivet cutting guns, made by the Rice Manufacturing Company, Indianapolis, Ind., for all territory east of the Rocky mountains.

F. W. McIntyre, who for the past 16 years has been connected with the Niles-Bement-Pond Company in Boston and Chicago, has been appointed sales manager of the Becker Milling Machine Company, Hyde Park, Mass.

F. G. Echols, for many years general manager of the small tools department of Pratt & Whitney Company of Hartford, Conn., has accepted a position as vice-president of the Greenfield Tap & Die Corporation, of Greenfield, Mass.

The General Tool & Supply Company, Saginaw, Mich., has been appointed to represent the Cleveland Milling Machine Company in the Saginaw district, and will carry a stock of milling machines and a large supply of cutters.

The Niles-Bement-Pond Company, Pittsburgh, Pa., has removed its office from the Frick building to 425 Seventh avenue. The company has also opened a new office and store at 116 South avenue, Rochester, N. Y., and will keep a stock of Pratt & Whitney small tools at both places.

Edwin T. Jackman, formerly of E. S. Jackman & Co., Chicago, has returned from Sheffield, England, where he has been investigating methods in connection with tool and alloy steels. On July 1 he became manager of the Boston, Mass., office of the Firth-Sterling Steel Company, McKeesport, Pa.

The North American Car Company, Chicago, has purchased a 23-acre tract at 135th street on a joint right of way of the Indiana Harbor Belt, the Baltimore & Ohio Chicago Terminal and the Chicago, Rock Island & Pacific, on which a car construction and car repair plant will be built in the neart future.

W. E. Millar has been appointed Pittsburgh district manager of the Cleveland Milling Machine Company and L. H. Mesker, vice-president of the company, has turned over the duties of sales manager to H. I. Miner. The company also announces that the J. Horstmann Company has been appointed French agent, under the personal direction of Henri Nourry.

George Shields, who was purchasing agent of the American Car Company, St. Louis, for ten years, and later served with the National Safety Car & Equipment Company since its organization, has become associated with The Dayton Manufacturing Company as sales representative, with headquarters at Dayton, Ohio.

The Allied Steel Castings Company, Harvey, Ill., which is controlled by the Chicago Malleable Castings Company and the Universal Draft Gear Attachment Company, Chicago, will install a 10-ton open hearth furnace to supplement the present Wellman-Seaver-Morgan 5-ton tilting furnace, which will be enlarged.

John T. Mahoney, purchasing agent of the Buda Company, Chicago, with headquarters at Harvey, Ill., has been promoted to sales manager of the truck and tractor engine department, to succeed Lon R. Smith, who has resigned to become general sales manager of the Midwest Engine Company, Indianapolis, Ind.

Joseph Robinson, formerly president of the Robinson Connector Company, Inc., announces that he is no longer connected with that company in any managerial capacity and has no supervision over the mechanical details of construction of the automatic hose connector, of which he is the inventor and which bears his name.

W. M. Carty, assistant superintendent of the American Brake Shoe & Foundry Company, Chicago, has been appointed superintendent of the Pine Bluff, Ark., plant of the Standard Brake Shoe & Foundry Company. The latter company recently purchased equipment to increase its capacity from 350 to 800 tons a month.

Major Charles E. Sholes has been elected vice-president, director and general sales manager of the Edison Storage Battery Company to succeed Harrison G. Thompson, who has resigned to organize and conduct the Transportation Engineering Corporation of New York. Major Sholes has heretofore been identified with the construction, operation and management of chemical industries. He was the active member of the Creditors' Committee of the Aetna Explosives, Inc., during the receivership. During the war he served as major in ordnance, first as chief of the chemical branch, which attended procurements of platinum, cotton linters, alcohol, acids, etc., and as army representative before the War Industries Board, and numerous other committees and boards. He was subsequently made contracting officer for the United States on the staff of Colonel Lamont, and retains his rank in the Officers' Reserve Corps. He is also chairman of the Society of Chemical Industry.

Major C. E. Sholes

Paul H. Schatzmann, foreign representative of the Joseph T. Ryerson & Son Company, is temporarily in charge of the company's interests in Brazil, Argentina and Peru. In August Mr. Schatzmann will sail for Europe, thence to India, China and Japan. A. L. G. Gentles will take care of the interests of this firm in Great Britain and Scandinavia, with headquarters in London.

Samuel F. Joor, consulting engineer of Chicago, has joined the American Steam Conveyor Corporation, Chicago, in the capacity of sales engineer. Mr. Joor has had wide experience in the conveyor field, at one time being western manager and sales engineer of the Jeffrey Manufacturing Company, previously being with the Link Belt Company.

The McMyler Interstate Company, Cleveland, Ohio, makers of car dumpers, locomotive cranes, ore and coal handling machinery, scraper and railroad equipment, with works at Bedford and Warren, Ohio, has opened a branch office in the Merchants Exchange building, San Francisco, Cal., with L. A. Somers as district representative.

W. L. Garland, manager of the Philadelphia, Pa., office of the Safety Car Heating & Lighting Company, has been elected a vice-president, with headquarters at Philadelphia, Pa. Mr. Garland was born in Blair county, Pennsylvania. He completed his apprenticeship at the Altoona shops of the Pennsylvania Railroad in 1892; he then served in various departments of the shops for five years, and later took up locomotive and car design. In 1901 he was appointed chief car inspector on the Pennsylvania Railroad. In 1907 he was appointed general agent of the Safety Car Heating & Lighting Company, and in 1909, was promoted to manager. Mr. Garland was commissioned a major in the Corps of Engineers and was assigned to the 87th Battalion, Military Railroads. He was released from active service on the signing of the armistice.

W. L. Garland

J. Stanley McCormack, formerly sales manager of the Bell Locomotive Works, Inc., New York City, will return to resume his old position on his discharge from the Naval Aviation Corps. Mr. McCormack enlisted at the outbreak of the war, training as a naval aviator, received his commission and was detailed to special experimental aviation development.

E. E. Maher has organized the Maher Engineering Company, with office in the Michigan Boulevard building, Chicago, to handle the sales and installation of Erie Engine Works high speed engines, Sims feedwater heaters, Dayton-Dowd centrifugal pumps, Wagner steam pumps and Pratt Engineering & Machine Company fertilizer and sulphuric acid machinery.

The Betson Plastic Fire Brick Company has been incorporated under the name of the Betson Plastic Fire Brick Company, Inc., with headquarters at Rome, N. Y. Frank J. Jewell is president and secretary, and Nelson Adams vice-president and treasurer. The company manufactures plastic fire brick for boiler furnace linings and baffle walls and "Hi-Heat" cement for use in boiler rooms.

Col. E. J. Hall, first vice-president of the Hall-Scott Motor Car Company, San Francisco, Cal., recently received the distinguished service medal from the government in recognition for designing the major portion of the liberty motor and also having an excellent record as chief of the Technical Section, Air Service, in charge of aviation engineering, inspection, and acceptance of airplane parts and equipment with the A. E. F. in France, England and Italy.

The International Oxygen Company, Newark, N. J., has appointed Preston Belvin district sales engineer, in charge of the Pittsburgh district sales work, with office at 1310 First National Bank building, Pittsburgh, Pa. The Chicago office, in charge of Philip G. Wesley, has been removed from 223 Railway Exchange building to 817-820 Chicago Stock Exchange building, 30 North La Salle street.

The manufacturing facilities of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., are to be increased by the addition of several buildings. The plant space now covers about nine acres and consists of 22 buildings. Recently two structures of brick and concrete were added. Contracts have been let and construction is already under way on the new buildings which will be of reinforced concrete and brick.

Marcel E. Cartier, sales engineer of the Joseph T. Ryerson & Son Company, Chicago, with headquarters at Paris, France, has returned to France after a few weeks' visit in this country. He will be joined in Paris by John H. Romann, sales engineer of the same firm. Messrs. Cartier and Romann will have charge of the company's business in France, Belgium, Holland, Switzerland, Italy, Spain and Portugal.

J. G. Carruthers, manager of sales of the Carnegie Steel Company, the Illinois Steel Company, and the Tennessee Coal, Iron & Railroad Company, with headquarters at Cincinnati, Ohio, has been appointed manager of sales for the Chicago district of the Illinois Steel Company at Chicago. He has been succeeded at Cincinnati by George H. Vant, who has been transferred from the Pittsburgh office of the Carnegie Steel Company.

The National Railway Appliance Company, New York, announce that by arrangement with Holden & White, Inc., Chicago, general agents, they are now prepared to offer in eastern and southern states a line of car heaters of all types. These include the Jewel hot blast forced ventilation stove, the hot water coal burning coil type, and a complete line of electric heaters, including cross seat, panel, truss plank and vestibule types.

Donald M. Ryerson, who for the past two years has been in the United States Navy, has received his discharge from the service and has returned to his duties as vice-president in charge of purchases and sales of the Joseph T. Ryerson & Son Company, Chicago. E. L. Ryerson, Jr., has also received his honorable discharge from the army, and has returned to the company as vice-president and works manager after nearly two years of absence.

E. A. Hitchcock has been elected vice-president of the Bailey Meter Company, Cleveland, Ohio. He will supervise the training of technical graduates for the company's service and sales departments. During the past six years he has been connected with the E. W. Clark & Co. Management Corporation as advisory, consulting and power sales engineer. Previous to that time he was professor of experimental engineering at Ohio State University.

J. W. McCabe, until recently district manager of sales at Buffalo, N. Y., for the Chicago Pneumatic Tool Company, Chicago, has been appointed special representative for the company's foreign trade department and will make an extended trip throughout the Orient, the Philippine Islands and Australia. W. H. White has been appointed acting district manager of sales at Buffalo to take charge of that territory during Mr. McCabe's absence.

Colonel R. P. Lamont, president of the American Steel Foundries, Chicago, has been awarded the distinguished service medal for "exceptionally meritorious service as assistant to the chief of the procurement division, later as chief of the procurement division and as a member of the claims board of the ordnance department," and for "rendering material assistance to the nation's industry in adjusting equitably outstanding contracts in full justice to employers and employees alike."

The Standard Car Construction Company and the Standard Car Equipment Company were merged on June 4, under the name of the Standard Tank Car Company, with head office and works at Sharon, Pa., and branch offices at New York, St. Louis and Chicago. John Stevenson, Jr., is president and G. F. Wood-Smith is vice-president of the new company, which will continue all the functions of the two companies, both as to the building and leasing of tank cars and all forms of steel plate construction.

The Buffalo Forge Company, Buffalo, N. Y., announces that Lieut. C. C. Cheyney has returned from service in the United States Navy, and is now in charge of its Chicago office and store. Lieut. Cheyney had charge of the mechanical repair shops at the naval aviation station, Pensacola, Fla., where from 500 to 1,200 men were employed during the war. Captain H. H. Downes, 12th U. S. Engineers (Railway), has returned from France, and after receiving his discharge expects to take charge of the Buffalo Forge Company's interests in the St. Louis territory.

The Bay City Foundry & Machine Company, Bay City, Mich., manufacturer of coal conveyors, saw mill machinery and hoists, has purchased the business of the Howlett Construction Company, Moline, Ill., manufacturer and builder of the Williams, White & Co., coaling stations. W. E. Howlett, manager and engineer of the Howlett Construction Company, will be manager of the railroad coaling station department of the consolidated company. This consolidation will unite the engineering facilities of the two companies and enable them to manufacture their own machinery.

The Central Steel Company, Massillon, Ohio, has opened new offices in Detroit, in the Book building, 35-37 Washington boulevard. Arthur Schaeffer, former assistant director of sales at the home office, Massillon, has been appointed district manager of sales, with Frank Gibbons as his assistant. Mr. Gibbons, who has just joined the organization, has been associated with the Carbon Steel Company for five or six years. He spent a great part of this time in the Carbon Company's Pittsburgh plant, and for the last several months has been district sales manager, with office at Detroit.

Tentative plans for a large increase in the capacity of the Pollak Steel Company, both at the Cincinnati and Chicago works, have been laid and are rapidly being worked out. D. E. Sawyer has been appointed general manager of sales, with headquarters at 120 Broadway, New York. Mr. Sawyer was formerly connected with the Illinois Steel Company, and was assistant steel director of purchases of the War Industries Board. The B. M. Parsons Company, 1001 Pioneer building, St. Paul, Minn., has been appointed northwestern sales representative in St. Paul, Minneapolis, Duluth and the Iron Range district.

The S. F. Bowser Company, Ltd., Toronto, Ont., which has for a number of years been manufacturing and selling Bowser gasoline and oil pumps, tanks and storage systems under the control of the parent company, S. F. Bowser & Co., Inc., Fort Wayne, Ind., has been re-organiezd under the Canadian laws to operate as a strictly Canadian firm. H. C. Christie, who has been for some time past connected with the Canadian factory of the S. F. Bowser Company, recently as sales manager, has been elected manager, with E. E. Cummings as factory manager. For a number of years, nearly the entire Canadian trade of the S. F. Bowser Company has been supplied from the Toronto factory, but this company has been under the direction of the home office at Fort Wayne. Through the present re-organization, the Canadian factory is to be operated and controlled as a separate institution. The officers are S. F. Bowser, president; S. V. Bechtel, vice-president; H. J. Grosvenor, secretary, and W. G. Zahrt, treasurer.

American Brake Shoe & Foundry Changes

William G. Pearce has retired as president of the American Brake Shoe & Foundry Company to become chairman of the executive committee, and Joseph B. Terbell, vice-president, has been elected president to succeed Mr. Pearce. Randolph Ortman, who has been president for one of the company's subsidiaries, has been elected a director, succeeding the late Joseph D. Gallagher.

W. G. Pearce

William G. Pearce, chairman of the executive committee of the American Brake Shoe & Foundry Company, was born at Marietta, Ohio, on June 11, 1859. He entered railway service in August, 1877, as a clerk in the office of the controller of the Missouri, Kansas & Texas, at Sedalia, Mo. He was later promoted to bookkeeper and chief clerk in the same office, and in August, 1879, left that road to take a clerical position in the auditing department of the Northern Pacific. He was successively promoted to assistant express auditor, assistant auditor of disbursements and auditor of disbursements in the same department, and in February, 1890, was appointed general purchasing agent. From May, 1892, to September, 1896, he was assistant general manager of the same road, and when the Northern Pacific was reorganized on the latter date, he was transferred to Tacoma, Wash., as assistant general superintendent. From August, 1900, to July 1, 1901, he was assistant to the president of the Northern Pacific, the Seattle & International, and the Washington & Columbia River, at the same time being general manager of the Seattle & International. From July, 1901, to March, 1902, he was general manager of the Northern Pacific, leaving railway service at the end of that time to become second vice-president of the Griffin Wheel Company. On June 5, 1905, he was also made general manager of this company, with headquarters at Chicago. He left the Griffin Wheel Company on November 22, 1910, to become vice-president of the American Brake Shoe & Foundry Company, and in May, 1916, was elected president, with headquarters at New York.

J. B. Terbell

J. B. Terbell, the new president, was born at Corning, N. Y., in February, 1863, and was educated at Hamilton College, graduating in the class of 1884 with the degree of A. B. After leaving college he served with the Fall Brook Railway, now the Pennsylvania division of the New York Central, with headquarters at Corning, N. Y., and later was vice-president of the Corning Iron Works. In 1897, he became president of the Corning Brake Shoe Company, and in 1902, was elected vice-president of the American Brake Shoe & Foundry Company, with headquarters at Chicago, in charge of the company's western business. In 1915, Mr. Terbell came to the New York office in connection with munition contracts for the British government.

Transportation Engineering Corporation Organized

Harrison G. Thompson resigned from his position as vice-president and general sales manager of the Edison Storage Battery Company on June 1, 1919, and has incorporated the Transportation Engineering Corporation, with offices at 200 Fifth avenue, New York. The officers are as follows: H. G. Thompson, president; F. V. McGinness, vice-president, and Harold H. Smith, secretary-treasurer. The new corporation will act as railway distributors for the Edison Storage Battery Company and for the Automatic Transportation Company, of Buffalo, N. Y. It will handle the Edison storage battery for train lights, railway signaling, multiple unit control, and for other purposes to which storage batteries may be applied. It will also handle the complete line of industrial trucks, tractors, and industrial engines manufactured by the Automatic Transportation Company, with such apparatus as charging equipment and other supplies incident to the above lines.

H. G. Thompson

Mr. Thompson became associated with the Edison Storage Battery Company in 1910, and was elected a vice-president in 1913. He was born at Weston, Mass., in 1875. In 1896 he entered the service of the Pullman Company, and after two years was made foreman of electricians. In 1900 he resigned to become foreman of the battery department of the Riker Motor Vehicle Company, but left the latter at the time of its absorption by the General Vehicle Company, of Hartford, Conn., to become associated with W. L. Bliss, one of the pioneers in electric car lighting development. In 1905 he entered the service of the Pennsylvania Railroad and was placed in charge of electric car lighting, with headquarters at Jersey City, N. J. About one year later he became electrical superintendent of the Safety Car

F. V. McGinness

Heating & Lighting Company, New York, and was in charge of that company's electrical laboratories during the development of its first electric car lighting system. In December, 1909, he was appointed manager of the railroad department of the Westinghouse Storage Battery Company and later, for a short time, was in the employ of the United States Light & Heat Company, New York. In July, 1910, he became manager of the railway department of the Edison Storage Battery Company; in July, 1915, he was appointed general sales manager, and became also vice-president of the company in July, 1918.

Frances V. McGinness, who recently resigned as railway sales manager of the Edison Storage Battery Company, is vice-president of the new corporation. He graduated from Columbia University, School of Engineering, with the degree of electrical engineer in 1910, and then spent a short time in the engineering departments of the New York Telephone Company and the New York & Queens Light & Power Company. He became connected with the Edison forces in 1911, being then engaged in experimental work in Mr. Edison's laboratory. At this time he also received a thorough training in the manufacture of the Edison battery. He was later appointed assistant manager of the railway department of the Edison Storage Battery Company, and in March, 1916, he was promoted to manager of the same department.

Harold H. Smith, electrical engineer of the Edison Storage Battery Company, becomes secretary-treasurer of the newly formed Transportation Engineering Corporation. Mr. Smith graduated from the Polytechnic Institute, Brooklyn, N. Y., in 1909, with the degree of E.E. For one year thereafter he was employed by the Pennsylvania Tunnel & Terminal Railroad, in the office of the chief engineer of electric traction, in connection with the New York electrification of the Pennsylvania Railroad. He then joined the staff of the laboratory of Thomas A. Edison, at Orange, and for several years was engaged in research work in connection with the Edison storage battery. Later he became connected with the selling department of the Edison Storage Battery Company in the capacity of engineer, and retained that position up to the time of his recent resignation.

H. H. Smith

The Stark Rolling Mill Company, Canton, Ohio, has appointed George W. Scott district manager for the Chicago territory, with headquarters at 1119 Marquette building. Mr. Scott was formerly Chicago representative of the Pittsburgh Steel Company. Thomas F. Murphy has been appointed district manager for the Canton territory. He was formerly connected with the American Sheet & Tin Plate Company.

The Metallo Gasket Company has recently been incorporated to manufacture gaskets and other packings, at New Brunswick, N. J., with the following officers: Zeno Schultes, president and treasurer; George Geipel, vice-president, and Stanley S. Geipel, secretary. Mr. Schultes was manager of the Goetze Gasket & Packing Company for about 14 years. George Geipel has been an erecting engineer for 35 years, specializing in refrigerating and steam power plants, and Stanley S. Geipel has had ten years' experience in mechanical engineering. The company will concentrate for a time on its metallo corrugated copper gasket with asbestos cord inlaid in the copper grooves or corrugations.

The Chicago Pneumatic Tool Company announces the election of Allan E. Goodhue as managing director of its English subsidiary, the Consolidated Pneumatic Tool Company, Ltd., whose offices are at 170 Piccadilly, London, and whose plant is in Fraserburg, Scotland. Mr. Goodhue will also have charge of European sales for the Chicago Pneumatic Tool Company. He was for a number of years connected with the sales department of the Midvale Steel Company and Midvale Steel & Ordnance Company in Philadelphia, Chicago and Boston, leaving that company in March, 1918, to enter the service of the government. From that time until January 1, 1919, when he became connected with the Chicago Pneumatic Tool Company, he was assistant manager of the steel and Raw Material Section, Production Division, of the Emergency Fleet Corporation.

Railway & Industrial Engineers, Inc.

The Railway & Industrial Engineers, Inc., with offices at 25 Broad street, New York, recently organized by J. E. Muhlfeld and V. Z. Caracristi announces that it has associated with it an experienced, competent and reliable staff of experts thoroughly familiar with domestic and foreign methods and practices, and offers to bankers, corporations and others its services in a representative, advisory, consulting or administrative capacity as follows:

J. E. Muhlfield

Organization, management and operation of railroad, public utility, industrial and manufacturing enterprises.

Examination of proposed capital and consequential expenditures for facilities or equipment to ascertain whether they are justified and will improve conditions, increase revenues or reduce costs of operation and maintenance.

Assistance in connection with plans for financing projected improvements and extensions.

Review or preparation of plans, specifications and estimates of costs of contemplated new construction work, or enlargements of existing facilities.

Rehabilitation and modernization of unprofitable undertakings, including, if desired, their temporary management and operation until satisfactory results are obtained.

Advisory or consulting engineers to insure that expenditures are made in a manner that will produce maximum economic results and reflect the greatest return to the properties, and provide the best security to the owners.

Advisors and conferees in labor problems and in the preparation of rules and regulations governing compensation and working conditions.

Preparing, passing upon or approving inventories, valuations and appraisals of properties and equipment.

Consulting engineers for exporters and importers and their foreign representatives, to co-ordinate specifications, prices and purchases for the best interest of each.

Reporting on inventions, new methods and processes, and assistance in the development of those having practical merit and commercial value.

J. E. Muhlfeld, who has been in transportation work for about 25 years, has, during the past ten years, been engaged in rehabilitation of roadway, terminals, shops and equipment on various railways, and more particularly in the design and development of the Mallet and other types of large steam locomotives in combination with the utilization of low-grade fuels for the purpose of increasing the average train load and reducing the costs of operation and maintenance on railroads in the United States, Canada and Brazil. He was born at Peru, Ind., on September 18, 1872, and studied mechanical engineering at Purdue University; he served as machinist, and then as locomotive fireman and engineer on the Wabash Railroad and later successively as engine house foreman and general foreman on the same road; master mechanic at Port Huron and Montreal, on the Grand Trunk; superintendent of machinery and rolling stock on the Canadian Government Railways; superintendent of motive power on the Baltimore & Ohio, and vice-president and general manager of the Kansas City Southern. During the past five years he has been located in New York and has specialized in railway and other valuation and improvement work and in the development of methods and appliances for the modernization of locomotives and central power stations for the purpose of reducing investment and fuel costs, utilizing waste heat, eliminating arduous labor, and increasing capacity.

V. Z. Caracristi has been engaged in railway and industrial work for the past 20 years, having specialized in locomotive, car and shop design and construction. He served as shop engineer and maintenance supervisor for the Richmond plant of the American Locomotive Company, and in the inauguration and installation of a uniform system of maintenance and shop betterment he was general maintenance supervisor for all of the plants of the same company. He assisted in the design and construction of the Washington, D. C., terminal and station, and later served as assistant to general superintendent of motive power of the Baltimore & Ohio, in charge of shop additions, construction and equipment, and general betterment of the design and construction of locomotives and cars, which included the design and construction of the first Mallet type locomotive. He was then engaged in carrying out improvements in the Brewster shops of the Wheeling & Lake Erie, and the Watervliet shops, and Carbondale mechanical terminal of the Delaware & Hudson Company; in charge of the layout, design and equipment of extensions to the Lima Locomotive Works, and various additions to plants and power houses of the American Locomotive Company. For the past six years he has been engaged in consulting work for various bankers on financial reports and suggesting improvements in industrial operating methods for controlled corporations. During this time he was engaged in development and commercial work on means and methods of burning coal in suspension. He will continue this same work in his new connection.

V. Z. Caracristi

CATALOGUES

Ash Disposal.—The American Steam Conveyor Corporation, Chicago, has issued another booklet on the question of ash handling facilities, entitled "Reducing Ash Disposal Costs." Of special interest is a diagram and description of a steam ash conveyor installed by this company, that saved over three dollars a day in ash handling costs. The experiences of a number of other users in securing ash disposal economies are described, and the text is illustrated with a number of diagrams and photographs of actual installations.

Chain Drives.—The Morse Chain Company, Ithaca, N. Y., in a 12-page pamphlet has reprinted from the 1919 Year Book of the National Association of Cotton Manufacturers an article by J. S. White, entitled "Chain Drives," which explains the advantages which may be secured in the textile industry from the use of chain drives in general power transmission work. This is a short synopsis of the general subject of chain driving and does not exploit any particular make or type of power chain, and includes engineering data useful in designing silent chain drives.

Electric Headlights.—The second edition of an instruction book covering the installation, care and operation of Sunbeam turbo-generators and headlights has been published by the Schroeder Headlight & Generator Company, Evansville, Ind. The information given in this book is quite extensive and not only deals with the Sunbeam turbo-generators and headlights, but contains considerable information pertaining to incandescent headlights in general, as well as many useful tables and formulae. It also contains many drawings and photographs showing detail parts and wiring arrangements.

Locomotive Coaling Plants.—A comprehensive book on locomotive coaling facilities, Rand gravity sand plan s and cinder handling equipment for railroads, describing a large number of representative installations, has been published by the Roberts & Schaefer Company, Chicago. The catalogue contains 68 pages, 9 in. by 11½ in., is well illustrated and includes erection drawings of several of the plants. It also describes and illustrates some of the special features of Roberts & Schaefer equipment, including the Schraeder automatic measuring feeder and a patented elevating bucket. Some interesting data is also given showing in detail the cost of handling coal, taken from carefully compiled records of a large railway system which employs 10 different methods of handling coal, comparing the cost of operating plants designed by the Roberts & Schaefer Company with the others.

Stoker Fired Locomotives.—The Locomotive Stoker Company, Pittsburgh, Pa., has published an attractive booklet of 96 pages, bound in heavy cardboard covers, illustrating some of the principal types of locomotives that have been equipped with mechanical stokers by the Locomotive Stoker Company, which include the largest and most powerful locomotives constructed, as well as the standard locomotives of the United States Railroad Administration. The various types of locomotives considered to be in the stoker class are grouped in sections, each page containing an illustration of a representative locomotive of different railroads, with a table of the principal dimensions. After each section is a tabulation which permits of a direct comparison of the like dimensions of all locomotives of that class. These tables should be of special interest to mechanical engineers designing new locomotives, as well as to those contemplating installing stokers on old locomotives.

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CONTENTS

Supporting the Sides of Wooden Gondolas

During the period when the shortage of cars for the coal traffic was acute, many roads put back into service open top wooden cars that would ordinarily have been retired and replaced with modern equipment. Since the price of cars has increased so greatly there seems to be a disposition to keep these cars in service. As a result it is a common thing to find wooden gondola cars under load with the sides bulging out so far that they are a menace to trainmen riding on the sides of other cars. In extreme cases, the side posts sometimes interfere with the safety appliances on cars on adjoining tracks.

There are several causes that lead to the excessive bulging of the sides of wooden cars. In many cases, the construction is such that the torsional strength of the side sills alone keeps the sides from spreading. If the underframe sags under the load, the distortion has a tendency to force the posts out still further. During recent years the increased difficulty of obtaining siding to extend the full length of the car has led to the use of short pieces, which further weakens the side.

Of the methods used to overcome spreading of the car sides the most common is the use of tie rods fastened to the tops of opposite posts. While this is a cheap and effective means of overcoming the trouble it should be used only as a temporary expedient, as the rods make the loading and unloading of long material very difficult. It is doubtful whether the bulging of sides can be entirely overcome on cars with weak underframes. Probably the most effective reinforcing for the sides on the majority of wooden cars is secured by adding diagonal tie straps to make the side act as a truss and by placing gusset sheets transversely in the center of the car to give lateral stiffness. If wooden gondolas are to be retained in service some effective method of strengthening the sides should be used.

Accidents Due to Locomotive Failures

Graphic comparisons of personal injury accidents resulting from failure of various locomotive details, classified by details and by years, included in an article appearing elsewhere in this issue, form a valuable summary of the work which has been done by the Division of Locomotive Inspection of the Interstate Commerce Commission during the seven years for which reports have been rendered, and throw into relief the points on which much improvement must still be made before a satisfactory situation can be said to have been reached.

One of the most striking comparisons brought out by the charts is the consistent and rapid decrease in the number of accidents due to boiler explosions from 1912 to 1915, followed by an almost equally rapid increase in the numbers of similar accidents in the years following, until a total of 90 was reached in 1918, only 7 less than the number reported in the fiscal year 1912. Considering the two principal classifications of causes of boiler explosions; that is, crown sheet failures due to low water, with and without contributing causes, it is significant that while the latter was reduced from a total of 69 accidents reported during the fiscal year 1912 to a minimum of 14 in 1913, and again increased to 38 in 1917 and 34 in 1918, the former had jumped from a minimum of 9 in 1915 to 51 in 1918, as compared with the largest number previously reported of 28 in 1913. The conditions reflected in these figures no doubt are due to the war, with the extraordinary demands for motive power which it created, and the unsatisfactory labor situation both as to quantity and quality which the railroads had to contend with during the year 1918.

Post mortems, however, are of little value unless some lesson may be drawn from them for future guidance. In this case the lesson seems to be obvious. It is that any neglect of firebox maintenance, particularly of the inspection and maintenance of boiler appliances such as water gage glasses, gage cocks, injectors, steam gages, safety valves, etc., results in grave and immediate danger. Whatever slighting of work the exigencies of such a situation as that created by the war may seem to require, safety demands that this requirement be met elsewhere than in connection with the parts just mentioned.

While perhaps not among the leading causes of personal injury accidents, boiler studs are a persistent cause of a sufficient number of accidents to give weight to the author's suggestion that their use be eliminated in every way possible. Aside from the element of danger accompanying the use of the studs themselves the practice of hanging air pumps, sometimes two of the large 8½-in. cross compound compressors, on the shell of the boiler, with the vibrations set up by the pumps in operation, subjects the boiler shell to stresses in addition to those due to the working pressure the magnitude of which it is practically impossible to evaluate. While past experience offers nothing to occasion alarm on this point, the uncertainty as to the future results of the tendency toward increasing the severity of these secondary stresses, together with the trouble and occasional accidents due to the studs themselves, clearly justifies an effort on the part of the designer to relocate the various appliances and details now secured to the boiler with studs.

The suggestion of the author that the annual reports of the Division of Locomotive Inspection of the Interstate Commerce Commission be studied by all mechanical department foremen having to do with locomotive repairs, if followed, should have very beneficial results. A careful analysis not only of the countrywide results, but of the conditions on their own lines would result inevitably in a tightening up of maintenance at the weak points. A decrease in the number of accidents would follow, and fewer locomotives would be taken out of service by the Commerce Commission inspectors for needed repairs.

Modern High-Speed Steel

In a paper discussing the subject of high speed steel, appearing elsewhere in this issue, John A. Matthews makes the interesting statement that "it is still a constant source of surprise to see tests conducted in which a steel that may appear of inferior analysis proves successful, whereas some of the other type of analysis judged from this viewpoint only would naturally be expected to prove the better steel," and he draws the conclusion that "it, therefore, seems that steel-making rather than chemical analysis is the first consideration, and so far we are not able to define or to specify all the elements which enter in from the melting to the finishing of the bar to produce first-class material." These statements coming from a present day authority in steel making are the results of long experience in the manufacture and study of tool steels and the conclusions drawn should be given careful consideration by every one engaged in the production or use of high speed steels. It has generally been thought that the chemical analysis of steel bears a direct relation to its utility and efficiency and this is usually true, but it has been demonstrated, in exhaustive tests, that the chemical analysis of a high speed steel may be ideal, but if the tool making process is not properly conducted, the resulting tool will not be of a satisfactory quality. The heat treatment of high speed steel by the tool makers has a most important bearing on the quality of the cutting tool and must be carefully done. Very often too much reliance is placed on the chemical analysis and generally known good qualities of some particular brand of high speed steel with the result that a superior grade of steel often produces a very inferior tool because of the failure of the tool maker to realize the importance of his treatment of the metal. Conscientious work by the tool maker will add greatly to the serviceability of cutting tools and effect a substantial economy in tool costs.

The Ultimate Locomotive Stoker

One of the most difficult and vital operating mechanical problems which the railroad world must solve is that of the further development of the mechanical stoker for locomotives. What is the ultimate locomotive stoker to be? The urgent need of efficient and economical locomotive firing is clearly apparent when it is realized that from 80 to 90 per cent of the millions of tons of coal burned annually by the railroads of the United States is burned on the locomotive. This immense amount of fuel not only represents a vast money value as a commodity, but it is directly related to the problems of labor and transportation. Each ton of coal used needlessly or wastefully means the economic loss of the labor necessary to produce it, and is also an added burden to the already overtaxed transportation facilities of the nation. The physical limits of hand firing have been reached because of the great increase in the size of fireboxes on modern locomotives, and it has become necessary to devise mechanical means of conveying and distributing the fuel to the grate. Several types of mechanical stokers have been built and developed to a remarkable degree of efficiency, so far as supplying the fuel to the fire is concerned, but it is quite generally conceded by the stoker manufacturers that in the use of stokers fuel economy is largely sacrificed for increased capacity and that in fireboxes within the physical limitations of the fireman the stoker is not as economical as hand firing. The use of the stoker results in the production of more ton-miles per locomotive mile, which increases the efficiency and economy of operation, but it does not produce that result with as small a use of coal as is manifestly desirable.

The methods now in use for mechanically feeding fuel to the locomotive firebox may be divided into three classes: the class by which the fuel, after being crushed in comparatively small pieces, is conveyed to the door of the firebox and then blown on and distributed over the grates by means of steam jets; second, the class by which the fuel is crushed and conveyed to the firebox in a similar manner, but is distributed over the grates by purely mechanical means, and third, the class by which the fuel is pulverized before being placed on the locomotive tender and is blown into the firebox and burned in suspension.

While all of these methods have great advantages over hand-firing on large locomotives at present, and each of them has great possibilities of future development and may prove to be the much sought solution of the problem, it is at the same time quite conceivable that a method differing radically from those now in use will be devised and will solve better than any of them the problem of feeding into the locomotive sufficient quantities of fuel in such a manner as to secure as efficient or more efficient use of the fuel than can be obtained by hand-firing. That the manufacturers of mechanical stokers are alive to the situation is evidenced by their constant efforts toward improvement in their devices. The more extensively stokers of the present types are used on the railroads, and the more study railroad mechanical men as well as manufacturers give to the improvement of their design and operation, the more rapidly the results theoretically possible will be obtained in actual practice.

Advantages of Large Water Capacity for Tenders

One large western railroad has recently adopted the practice of equipping locomotives with tenders having a very large water capacity. The results secured have been so favorable that an analysis of the advantages and disadvantages of high water capacity will be of interest. The most evident benefit is the reduction of the number of water stops, which saves fuel and wear on the brake apparatus and reduces the running time, thus often effecting a saving in the wages of the train crew. Incidentally, the larger water capacity may permit of passing water tanks where the water is of inferior quality, or where the location makes starting difficult, which under certain conditions may be very important. Against these advantages must be balanced the increased tonnage hauled and the additional maintenance cost.

The amount by which the capacity must be increased to permit a reduction in the number of water stops varies under different conditions. With the usual spacing of water tanks an increase of 50 per cent will in most cases make it possible to run past one more tank between stops. In order to bring out the economies resulting from the elimination of the stop, assume a locomotive having a tender with a capacity of 8,000 gal. of water operating over a division 100 miles long on a run that necessitates taking water at five intermediate stops and coal at one point on the division. By increasing the water capacity to 12,000 gal. the number of water stops might be reduced from five to three and since a conservative estimate of the average cost of a stop is 60 cents, the saving per trip would be $1.20. As the extra weight of water would not increase the number of trains, the cost of hauling the increased weight would be limited to the cost of the additional fuel burned. The gross ton miles would be increased 833 ton-miles. Figuring the coal consumption at 250 lb. per 1,000 ton-miles and the cost at $3.50 a ton the extra fuel would cost 36 cents. Even though there is considerable increase in the cost of maintenance of the larger tender, there should be a substantial economy effected by its use.

Operating conditions will determine the extent to which the increase in water capacity can profitably be carried. In passenger service there would be no economy in providing capacity in excess of that required by the train between station stops where water tanks are located. For freight engines, however, the capacity could profitably be increased to the amount consumed between coaling stations where stops are necessary. This would require about twice the water capacity now usually provided.

The Shop Craft Strike

The scattering strikes of railway shop men, variously estimated at the time of going to press as involving from 100,000 to 250,000 of the approximately 450,000 men thus employed, and which will, if the threats of some of the leaders of the shop crafts unions are carried out, paralyze the transportation system of the country, seem to mark the breakdown of the policy followed by the Railroad Administration in dealing with the labor situation in the shops.

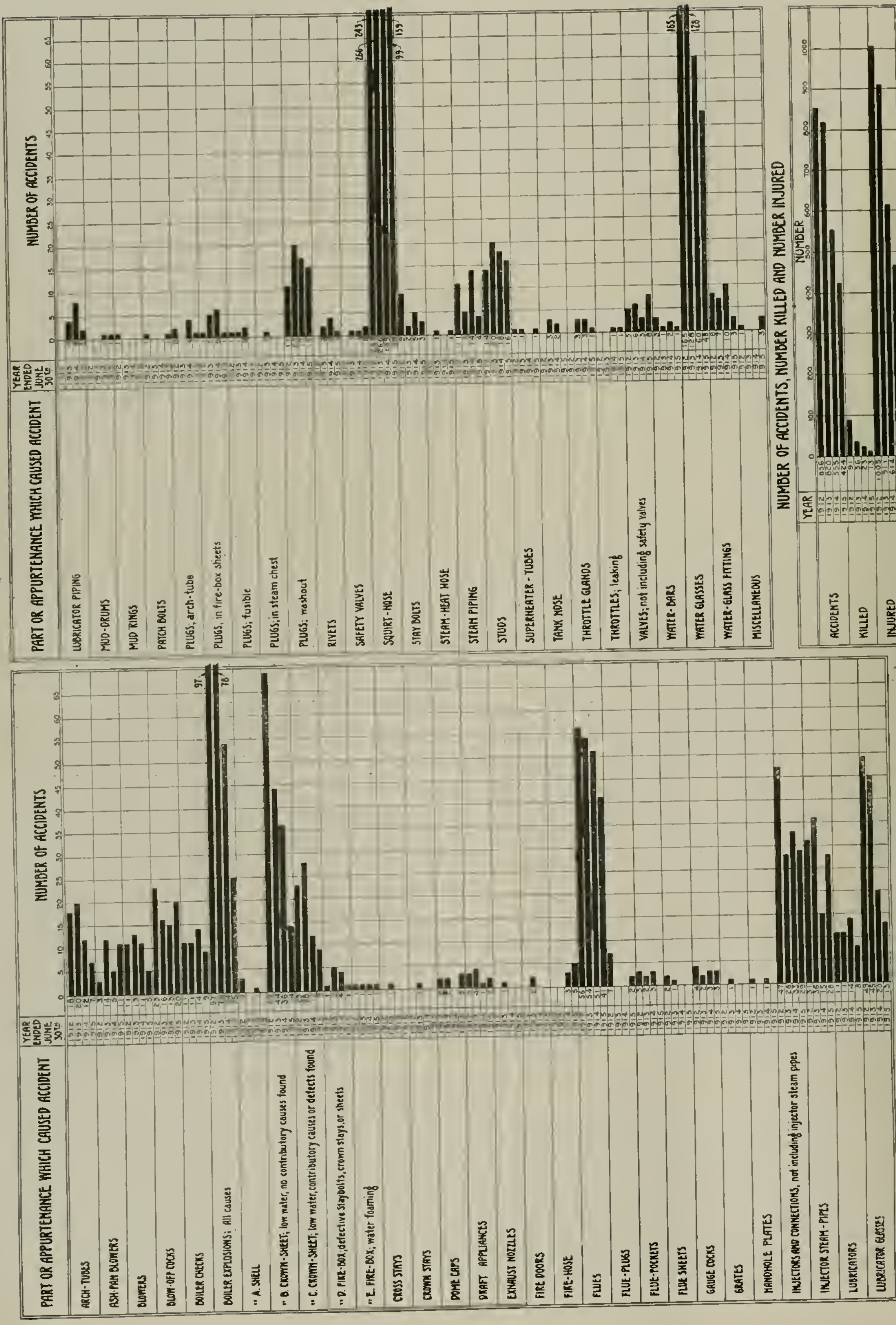
One of the early acts in the administration of Director General McAdoo was the creation of a railroad wage commission to investigate and recommend adjustments and increases required to meet the special conditions created by the war. During the latter part of 1915 and early in 1916, conditions at which time were assumed by the wage commission as the basis of its work, railway mechanics were receiving from 34 to 38 cents an hour, with earnings ranging approximately from $75 to $90 a month. During the intervening two years, however, increases had been given by the railroad companies, so that the average monthly earnings of mechanics for 1916 had ranged from $90 to over $100, and for 1917, from $105 to about $120. The award proposed by the wage commission, based as it was on conditions as of December, 1915, was modified by the Director General in General Order No. 27 in order that the shop men might receive some increase and a minimum of 55 cents an hour was established for mechanics. This, however, met with immediate expressions of dissatisfaction, accompanied by a number of local strikes, and was followed by a request for an increase in the mechanics' rate to 75 cents an hour. In July, Supplement No. 4 to General Order No. 27 was issued, raising the mechanics' rates to 68 cents an hour, which rate was to be retroactive to January 1, 1918. It also authorized the eight-hour day after August 1, with time and a half for overtime. Incidentally, Supplement No. 4 resulted in the destruction of piece work.

According to the wage commission the cost of living had increased by from 37 to 40 per cent from January 1, 1916, to January 1, 1918. The Bureau of Labor Statistics of the Department of Labor quotes average prices of a wide range of food products, the average increase in price of which was 16 per cent from January, 1918, to January, 1919. As food is the largest single item entering into the cost of living, it hardly seems possible that the cost of living in January, 1919, or about the time the present demands were presented, had advanced more than 60 per cent since the beginning of 1916, although the labor leaders base their present wage demands on an alleged increase of some 80 per cent. Judging from the month to month increases in food prices since that time, it is impossible to conceive that a 100 per cent increase has taken place up to date. But the wage rates of the shop men have increased approximately 100 per cent over those in effect late in 1915. The increase in the cost of living, therefore, seems clearly to be a specious and fallacious argument in connection with the present wage demands.

The source of dissatisfaction is not merely the increase in living costs. The spread of labor union policies, which it was supposed would cause satisfaction, probably is responsible for much of the dissatisfaction. Take the piece-work situation: Men who had been averaging good earnings on a piece-work basis before the issuance of Supplement No. 4, found themselves under the provisions of this order, earning practically as much as before without any effort on their part, and what was worse, with their hands tied so far as their ability to further increase their earnings by their own efforts was concerned. A source of dissatisfaction and unrest among piece workers was thus created. Another provision of Supplement No. 4 was the institution of the eight-hour day with time and a half for overtime after August 1, 1918. This resulted in a temporary increase in earnings, a reduction in which soon followed when overtime work was discontinued. A reduction of earnings is never a source of satisfaction and good feeling.

The failure of the liberal policy of the Railroad Administration in its dealings with labor to meet with a response in the way of stimulated effort or co-operation is generally conceded and has been commented on in some of its phases in these columns. The following case is typical in kind, if not strictly in degree, of a general condition: A certain engine terminal in eastern territory, which in 1916 despatched 100 engines daily in addition to taking care of some heavy Mallet repairs, employed about 200 men in two shifts. Since the first of this year the same terminal has employed over 500 men in three shifts. From $15,000 to $16,000, the payroll has increased to $130,000 a month in the same period.

Just what will be the outcome of the present situation no one can predict. It is, however, quite evident that no satisfactory and stable working arrangement can be effected until the worker and the manager in their relations with one another are free to and do give expression in what they say and what they do to their own inherent sense of justice.



Compiled from the Annual Reports of the Chief Inspector of Locomotive Boilers to the Interstate Commerce Commission

Fig. 1—Personal Injury Accidents Resulting from Failures of Locomotive Boilers and Their Appurtenances—1912 to 1915 Inclusive

Injuries from Locomotive Failures

Suggestions for Their Reduction Based on a Digest of the I. C. C. Locomotive Inspection Reports

BY JOHN L. MOHUN
Assistant to Consulting Engineer, Union Pacific System

By presenting the personal injury accidents, as listed in the several annual reports of the Chief Inspector of Locomotive Boilers to the Interstate Commerce Commission in a comparative graphic form, with an analysis of the cause of the principal locomotive failures which caused these accidents, it seems possible that means may be devised whereby accidents due to such failures may further be reduced.

As these reports emanate from a source independent of the railroads and are national in scope, tendencies toward faulty construction or improper maintenance are naturally more forcibly brought out than in the case of the usual railroad mechanical department reports covering locomotive failures, which are confined to a single or a system of roads. Therefore, serious attention should be given these reports and the recommendations as to improvements made by the Chief Inspector.

The Federal Locomotive Boiler Inspection Law enacted February 17, 1911, made it unlawful to operate a locomotive with its boiler in an unsafe condition and prescribed rules and regulations for the inspection and test of the boiler. The law further requires the railroads to report to the Interstate Commerce Commission all accidents resulting from locomotive boiler failures or their appurtenances causing serious personal injury or death. The Commission considers a serious injury as one causing the person involved to be incapacitated for more than three days in the aggregate within ten days immediately following the accident. The law also requires the facts concerning such accidents to be investigated by the Chief Inspector of Locomotive Boilers or one of his assistants.

The Congress on March 4, 1915, amended the original Locomotive Boiler Inspection Law by making its provisions apply to the entire locomotive and its tender and all their appurtenances. The features as to reporting and investigating accidents remain the same.

Attention is invited to the charts, which present the personal injury accidents in a comparative graphic form for the years 1912 to 1918 inclusive. As the law at first related solely to the locomotive boiler, Fig. 1 lists the personal injury accidents chargeable to the failure of locomotive boilers and their appurtenances only, for the years 1912 to 1915. As the law was later amended to cover the locomotive and its tender, Fig. 2 covers all personal injury accidents chargeable to the entire locomotive and tender, and their appurtenances, for the years 1916 to 1918 inclusive.

It is obvious that certain tendencies indicated by these charts must be interpreted with reservations, as there are a number of conditions varying from time to time which should be given consideration before drawing definite conclusions, such as the amount of traffic, number of locomotives in service, weather and labor conditions, and the very abnormal state of affairs brought about by the world war in the past few years. However, these charts and the information given in detail, covering individual accidents in the annual reports of the Chief Inspector, bring out certain features in such a pronounced manner that quite definite conclusions can be drawn notwithstanding the effect of these variable conditions.

The predominating feature in Fig. 1 is the consistent reduction each year in the total number of accidents, number killed, and number injured. In the majority of cases this is also true of the number of accidents chargeable to the failure of individual parts of the boiler or its appurtenances. Evidently the material falling off in traffic during the years 1912 to 1915 had considerable to do with reducing the number of accidents, but undoubtedly a large amount of this improvement was directly attributable to the rules and regulations governing the inspection and testing of locomotive boilers and their appurtenances, put into effect in 1911 and 1912 by the Division of Locomotive Boiler Inspection of the Interstate Commerce Commission, and the general co-operation of the railroads, locomotive builders and the railway supply companies.

Fig. 2 shows a reverse state of affairs, with the exception of the number killed, in this respect 1918 showing an improvement over 1917.

The increased number of accidents between the years 1915 and 1916 was primarily due to the extension of the law to include the entire locomotive and tender; and the increase each year from 1916 to 1918 no doubt was principally caused by the abnormal condition the railroads were working under during these years, resulting from the war and the severe winter of 1917-1918. It is obvious that even if conditions had been normal during these years, the same ratio of reduction in accidents which occurred in the first few years after the Locomotive Boiler Inspection Act went into effect, could hardly have been expected.

The principal accidents causing personal injuries shown by these charts were due to the failure of the following locomotive parts or their appurtenances: Boilers, flues, grate shakers, injector and connections, injector steam pipes, reverse levers, squirt hose, lubricator glasses, water glasses.

BOILERS AND THEIR APPURTENANCES

Of these items, boiler failures are, of course, the most serious, both in the loss of life and damage to property. Fig. 1 shows a large reduction in the number of boiler explosions from all causes, there being 97 in 1912 as compared with 25 in 1915. Fig. 2 shows just the reverse, there being an increase in the number of boiler explosions from all causes from 41 in 1916 to 90 in 1918.

As will be seen by these charts, boiler explosions due to low water, no contributory cause, fell off fairly constantly from 69 in 1912 to 34 in 1918; but explosions due to low water, contributory causes or defects found, increased during the same period from 23 to 51.

The following cases of contributory causes to boiler explosions are taken from the Chief Inspector's reports for the years 1912 to 1918, and a considerable percentage of all boiler explosions disclose similar self-evident defects.

"A bad leak was found in packing nut of top water glass cock; no packing in nut at all, and valve handle was wired to prevent it from being blown out. Union nut in steam pipe to water glass was very loose and had been leaking badly. Such leaks cause water to raise in the glass and show an incorrect water level. These leaks had been reported four times previous to accident."

"Improperly located water glass and gage cocks; lowest reading of water glass one-eighth inch above highest point of crown sheet; bottom gage cock 1⅝ inches above highest point of crown sheet; locomotive received new fire box nine months before accident and had evidently been operating in this dangerous condition for that length of time."

"Obstruction in bottom water glass fitting; bottom gage cock stopped up with solid scale and inoperative and water glass cocks and three gage cocks not extending through reinforcing plates."

Compiled from the Annual Reports of the Chief Inspector of Locomotive Boilers to the Interstate Commerce Commission

Fig. 2—Personal Injury Accidents Resulting from Failures of Locomotives and Tenders and their Appurtenances—1916 to 1918 Inclusive

"Both injectors defective; injectors reported 14 times previous to accident."

"The failure occurred along the edge of the longitudinal seam where a crack had formed completely through the plate in several places and more than halfway through for the entire length of the course. The engineer had reported a leak under the jacket at this point three times immediately prior to the accident."

"Crown bolt beads defective and excessively calked, due to having been overheated some time previous."

"Crown sheet failure, overheated; water foaming badly; reported six times by different engineers prior to accident, but boiler not washed."

"Twelve crown bar braces were defective on account of seven pins missing; four pins broken and one brace broken. Scale was found in the crowfoot holes, where pins should have been, showing that pins had been out for some time."

"Mud ring cracked and leaking badly; reported 18 times, and crown bolts reported leaking badly 16 times within 30 days prior to the accident."

"Opening in fusible plug filled with sediment or slag, rendering it inoperative; report of inspection made three days before accident occurred, shows fusible plug removed and cleaned, yet it was found in this condition and had to be cut out of the sheet."

It is realized that quite often locomotive running repairs have to be made from day to day, under the most trying circumstances as to constant demand for and shortage of power, lack of proper facilities, and other unfavorable conditions. These facts should not, however, be considered valid reasons for placing locomotives in service without knowing that such serious defects as those listed above do not exist.

BOILER STUDS

The charts show a yearly average of about fourteen personal injury accidents chargeable to the failure of boiler studs, but the Chief Inspector's reports disclose many times this number found by the district inspectors in a leaky or defective condition. A large number of accidents are shown to be due to studs blowing out on account of improper application, in some cases not more than two or three threads having entered the sheet. A number of accidents were also caused by studs failing, while being tightened, under pressure. The Chief Inspector in his sixth annual report states that studs should not be repaired by calking and under no circumstances should an attempt be made to tighten them while there is steam pressure on the boiler.

An effort should be made to reduce as much as possible the large number of studs now being placed in the boiler for attaching various parts and auxiliary devices, especially when the device produces vibrations or shocks on the studs, such as is the case with air compressors and reverse lever quadrants.

In connection with large Mallet locomotives, several railroads and the Railroad Administration have placed the air compressors on the front of the locomotive and it is believed that this should be followed generally with respect to all large locomotives for the reasons that all boiler studs are dispensed with, the compressors can more readily be looked after by the engine crew when running and as two compressors are usually used on large locomotives, by placing one on each side of the center line an equal weight distribution is obtained. By placing the compressors on the front, instead of on one side of the locomotive, more free air would be passed over the air cylinders when running, thus securing a better cooling effect.

The reports show a number of failures of studs which attach the reverse lever quadrant, undoubtedly due to vibration set up in the reach rod. The use of a power reverse gear wherein the shocks or vibrations are cushioned by the air in the cylinder, would seem to offer means for avoiding this trouble.

There are also a number of minor parts fastened to the boiler by studs which by a little study on the part of the designer, could be avoided; for example, usually two steps are provided in connection with the sand box, requiring altogether four boiler studs. A light ladder could readily be substituted; secured at the top to the base of the sand box, and at the bottom to the running board.

On all of the locomotives recently ordered by the Railroad Administration, with the exception of the switchers, the bell stand is attached to the front end. This is good practice, as it is not only the logical place for the bell, but all boiler studs for attaching the stand are dispensed with. Such matters as the fastening of sand box steps and bell bases may seem of little moment, but there are many such parts which may be similarly treated to eliminate boiler studs, which taken in the aggregate assume considerable importance.

When a new firebox, back end or an entire boiler is applied to an old locomotive it is generally renewed in kind, with the possible exception of the application of a superheater and a brick arch, and certain improved features of construction developed in the past few years are not usually employed, although such improvements may cost little or nothing. In renewals of this kind where boilers have originally been attached to the frame by means of pads and clamps in connection with which a large number of studs are placed in the firebox sheets, it would seem advisable to substitute furnace bearers or furnace expansion plates attached to the mud ring of the firebox, thus dispensing with the troublesome boiler studs. If the side grate bearers had originally been supported by studs placed in the side sheets of the furnace, it would also seem desirable when renewing a firebox or back end to substitute the more modern method of supporting the grate bearers; that is, by brackets fastened by studs placed in the mud ring, thus further dispensing with boiler studs.

When a firebox, back end or a new boiler is installed, the steam turret and possibly the injectors could be placed outside the cab; thereby reducing the possibility of accidents due to the failure of their steam connections.

BOILER WASHOUT PLUGS

These reports show that quite a number of accidents are caused by boiler washout plugs being tightened while under pressure. After a boiler has been washed, filled with water and fired up, if a washout plug should be found leaking it is a very natural temptation, in order to save time and labor, to attempt to tighten the plug while under pressure. But the very fact that the plug is leaking indicates that the fine threads may have been crossed and it should in no case be touched with a wrench while the boiler is under pressure.

ARCH TUBES

The charts indicate a yearly average of about 11 accidents caused by the failure of arch tubes. The reports show the major number of failures due either to an accumulation of mud within the tubes or faulty setting. In 1912 there were 18, and in 1918 only 9 accidents chargeable to arch tubes. Considering the fact that the number of arch tubes in service increased in this period from approximately 40,000 to 100,000, the showing may be considered a very satisfactory one and indicates that those concerned realize the importance of keeping arch tubes free from obstructions in order to obtain proper circulation through the tubes and thereby prevent them from being burnt.

TUBES

By referring to the charts it will be noted that personal injury accidents due to the failure of tubes fell off quite consistently from 56 in 1912 to 40 in 1918, most of the failures being due to poor welds; but the reports show a much greater improvement in the number of defective or leaky tubes found by the district inspectors, the decrease being about from 2,270 in 1912 to 565 in 1918. Unquestionably this improvement was largely due to better methods of setting tubes, electric welding of beads, and the rule of the Commission limiting the use of tube plugs and specifying, when they are used, they must be tied together with a rod through the tubes.

SUPERHEATER FLUES

Only nine accidents are shown by the charts for the years 1912 to 1918 due to the failure of superheater flues, which indicates that these flues are being well maintained, especially when it is considered that the total number of superheater tubes in service increased from about 125,000 in 1912 to 980,000 in 1918.

AUTOMATIC FIRE DOORS

In order to reduce as much as possible the serious consequences of firebox, flue, and arch tube failures, the Chief Inspector in his annual report for the year ended June 30, 1917, recommends that all new and all locomotives then in service, when receiving general repairs, be provided with a mechanically operated fire door, so constructed that it is only open when the operator places his foot on the pedal. He further states that with the ordinary swing door, such boiler failures invariably result in blowing the fire door open and discharging steam and boiling water, together with the contents of the firebox, into the cab of the locomotive, seriously or fatally burning persons therein. He also directs attention to the fact that with the automatic fire door, the door will remain closed if the failure occurs while it is closed; and if the failure takes place while it is open, it will automatically close the instant the fireman's foot is removed from the operating device, thus preventing the direct discharge of steam and scalding water into the cab of the locomotive.

From the above it would appear that the automatic fire door is a most important safety device, and its use is well warranted solely for this reason and regardless of its coal saving features, which are generally recognized.

GRATE SHAKERS

As disclosed by Fig. 2, personal injury accidents chargeable to grate shakers amounted to 23 in 1916; 51 in 1917 and 39 in 1918. Reports show these accidents principally due to improper maintenance of the grate shaker mechanism, such as worn or missing pins and hand shaker bars slipping off staff, due to wear in the socket and the lever stub. The use of steam operated grate shakers should preclude the possibility of such accidents.

As a large number of grate bars on old locomotives are connected by single rods placed on one side of the lug on the grate bars and employ rather small pins, lost motion is soon set up and the whole grate shaker mechanism becomes loose and wobbly and when in this condition is liable to cause an accident.

It would appear advisable in such cases to substitute a more modern method consisting of double connecting rods, one placed on each side of the grate bar lugs with large, substantial pins. This change could be made at a relatively small cost. If it should require a change in, or relocating of, the lugs on the grate bars, this could readily be taken care of at practically no increase in cost, as grate bars have to be renewed constantly. At the same time it might be found expedient to redesign the grates in order to conform to more modern practice, especially as to providing maximum air openings obtainable without the loss of coal, thereby increasing the coal burning efficiency of the grates. This can be done at small cost due as stated before, to the fact that grates have to be replaced repeatedly.

As coal dust frequently accumulates on the top of the grate lever stubs, the socket of the detachable hand bar should be so arranged that there would be at least one inch clear space between the bottom of the socket and the top of the stub lever when the socket is placed home on the stub. Further, a hole should be drilled through the sides and at the bottom of the socket in order to allow any coal which may have lodged on the top of the lever to fall out.

INJECTOR AND CONNECTIONS

The charts show that personal injury accidents chargeable to the failure of injectors and connections (not including injector steam pipes) decreased almost constantly from 47 in 1912 to 23 in 1918, and accidents chargeable to injector steam pipes fell off in the same period from 31 to 16. The reports indicate that practically all of these accidents were due to the union nuts or brazed on collars. Failure of union nuts were due in most cases to threads stripping, nuts too large or broken by the use of improper tools, such as hammer and chisel. A large number of accidents are shown to be due to the failure of union nuts while being tightened under pressure. This is, needless to say, a dangerous undertaking and should be avoided. Failure of the brazed collars and sleeves is generally due to poor brazing. The district inspectors' reports disclose the fact that there were 26,342 injectors and connections found defective in 1913 and that there was practically a consistent reduction to 5,803 in 1918. Even the latter figure seems to indicate a rather bad state of affairs as to the proper maintaining of so important a piece of apparatus, especially in view of the Commission rule requiring the injectors to be tested before each trip.

Undoubtedly the use of non-lift injectors placed outside of the cab, and the so-called "mechanical" pipe joints in place of brazed collars, both of which are now coming into general use, will materially improve conditions in this respect.

REVERSE LEVERS

Fig. 2 shows that there were 38 accidents in 1916, 29 in 1917 and 40 in 1918 chargeable to the failure of reverse levers.

District inspectors' reports disclose that there were 60 defective levers found in 1916, 178 in 1917 and 244 in 1918. Practically all of these accidents are shown to be due to the reverse lever slipping out of the quadrant, caused by the worn condition of teeth of the quadrant or lever latch, defective latch springs or dirt in quadrant. On account of the incessant vibrations which the valve motion sets up in the reach rod it is very difficult to keep lost motion out of the teeth of the quadrant and reverse lever latch. The writer believes that the most practical way to reduce accidents of this kind is by the use of a power reverse gear in which the vibrations in the reach rod are cushioned and absorbed by the compressed air within the reversing cylinder.

SQUIRT HOSE

There were 266 personal injury accidents in 1913 due to squirt hose. The number has quite consistently been reduced to 47 in 1918. District inspectors' reports show 3,711 squirt hose or applications found defective in 1913, which was consistently reduced to 511 in 1918. Practically all of these accidents are shown to be due to the squirt hose blowing off, parting at splice or bursting caused by defective hose or clamps. These accidents usually resulted in scalding the fireman, as until recently the water for the squirt was generally taken from the delivery pipe of the injector. Undoubtedly the very satisfactory improvement made in the number of accidents chargeable to this device is due to the fact that the attention of all concerned was focused on the large number of accidents caused by such an insignificant piece of apparatus, with the result that a one piece hose of better quality, sometimes armored, was used and more substantial clamps and attachments generally provided. A considerable amount of credit for this improvement is also due the several injector manufacturers who have developed squirt hose attachments which deliver water cool enough to be handled without danger.

One of the large eastern railway systems uses a cold water sprinkler or squirt arrangement, consisting of a small reservoir of about ten gallons capacity, placed inside and at the bottom of the tender tank. The reservoir is provided with a strainer and check valve through which water is admitted from the tank of the tender, the sprinkler hose connection being taken from the bottom of the reservoir. Air from the main reservoir is admitted to the top of the small water reservoir through a hand operated valve located at a convenient place on the tender. When the air pressure is turned on the check valve closes and cold water is forced from the reservoir through the sprinkler hose. When the air pressure is released the reservoir is automatically recharged with water through the check valve.

LUBRICATOR AND WATER GAGE GLASSES

Accidents chargeable to the failure or breaking of lubricator glasses fell off quite consistently from 49 in 1912 to 12 in 1918, and those due to the failure of water gage glasses from 165 in 1912 to 20 in 1918. The decided improvement between the years 1912 and 1918 must be largely attributed to the Commission's rule requiring all tubular water and lubricator glasses to be provided with a suitable shield, although the reports indicate that there are still occurring a number of accidents chargeable to inefficient shields. The more general use of the "bulls-eye" type of lubricators and the "reflex" type of water gage also probably contributed to this improvement; however, the reports show that the glasses in these two devices are also failing and causing accidents.

AIR RESERVOIRS

Fig. 2 indicates that there were from four to six accidents each year chargeable to the failure of air reservoirs generally caused by corrosion through the underside of reservoir. In at least one case the material had wasted away until only 1/64 in. remained at the time of bursting. Possibly these reservoirs were old and had not been enameled and baked inside and out, as has been the practice of the air brake companies for the past several years. However, it would seem that if these reservoirs had received the proper hydrostatic and hammer tests, as prescribed by the rules, the thin sheets would have been detected and the accidents avoided.

BLOW-OFF COCKS

The number of accidents chargeable to the failure of blow-off cocks is shown to have been from 15 to 20 each year since 1912 and to have been due to defective threads, cocks, or their operating mechanism. This would seem to indicate that these parts are not being maintained as well as their importance requires. As the cocks which are now generally being used are of an improved type and of more substantial construction than those formerly used, an improvement in this respect may be looked for in the future.

DRAW GEARS

Personal injury accidents due to the failure of draw gears fell off from 22 in 1916 to 11 in 1918—probably the result of the rigid rules of the Commission governing the proper maintenance of draw gears. These accidents are generally shown to have been due to the pins or holes in the bar being worn, or to flaws or defects in the materials of which they are made. A number of these accidents are also reported as due to excessive lost motion between locomotive and tender and in several cases the safety chains are stated as having been too long. When one of the pins or the drawbar breaks, the entire shock due to the momentum of the locomotive is taken by the safety chains or safety bars, and on account of the slack which it is necessary to provide in these parts, they generally fail to hold the locomotive and tender together. Naturally the results of such accidents are usually of a serious nature. The type of gear whereby a single heavy safety bar is placed directly under the drawbar and on the center line of the locomotive, thus requiring a very small amount of slack, would seem to offer means whereby accidents of this kind could practically be avoided.

GENERAL CONCLUSIONS

The writer is unable to say to what extent the annual reports of the Chief Inspector are in the hands of mechanical department employees, but all such employees as general foremen of locomotive department, roundhouse foremen, foremen boilermakers and their subforemen should be supplied with them as issued, for the reason that they not only list and classify all accidents, but the cause and circumstances under which they occur are clearly stated. They should also be of considerable value to the several locomotive builders and to all companies furnishing locomotive appliances.

The intelligent interpretation of the causes of these accidents should not only reduce their number, but it should also tend to improve the efficiency of the men and equipment, which is of the utmost importance at the present time on account of the prevailing high cost of labor and material.

The Chief Inspector's reports reveal the fact that personal injury accidents, due to the failure of certain locomotive parts, are occurring to a much greater extent on some roads than on others in proportion to the number of locomotives operated by each road and allowing for other varying conditions. This prompts the suggestion that the mechanical department of each railroad check the design, material and maintenance methods of all parts which are shown by these reports to be causing them an excessive number of failures, with the design and maintenance practice of similar parts showing the best performance on locomotives of other roads operating under approximately the same conditions.

When the Congress passed the original Boiler Inspection Law in 1911 it was thought unnecessary by a number of railroad men, and resented by some as an unwarranted interference with their prerogatives, but largely due to the practical manner in which the provisions of the law have been administered by the Division of Locomotive Boiler Inspection under the Interstate Commerce Commission, its beneficial results are now fully recognized and railroad men generally are heartily co-operating with the Commission.

The writer, having had actual roundhouse experience, fully realizes that it is a very simple matter to analyze locomotive accidents and to offer suggestions for their avoidance in the future, in comparison with the very difficult problem of actually maintaining running repairs in a thoroughly practical manner under the quite common conditions of shortage of power and inadequate facilities. He therefore trusts that any criticisms made in this article will be understood in this light, and as having been offered solely as constructive criticism for the possible betterment of the future service.

STANDARDIZATION IN FRANCE AND BELGIUM

BY ROBERT E. THAYER

European Editor

Equipment standardization in France and Belgium is being considered principally for the reason that large quantities of new equipment must be built eventually and vast quantities must be repaired because of the great amount of damage done to the cars and locomotives in both countries by the Germans during the war, and also because of the fact that the maintenance of equipment in both these countries had to be seriously neglected.

Four of the important French railways, namely, the Paris-Lyons-Mediterranean, the Paris-Orleans, the Midi, and the State railways, have formed a committee for the consideration of standard equipment. Two designs of locomotives are being considered, one of the Pacific type for passenger service, which will have driving wheels of about 78 in. in diameter, and a Mikado locomotive for fast freight and heavy grade passenger service, having driving wheels of about 65 in. in diameter. It is very interesting to note that these locomotives will be of the two cylinder, simple, superheater type. With the improvements in the design of this type of locomotive, it is now generally conceded in France that the economies obtained from the compound locomotives as compared with a good design of two cylinder, simple locomotive using superheated steam, do not warrant the increased first cost, the increase in the cost of maintenance and the added complication of the compound locomotives. Furthermore these standard engines will have a lower factor of adhesion than is customarily used in America. The design will probably not give a factor any higher than 3.5.

The traffic conditions in France are such that a high speed locomotive is needed both in passenger and freight service. The Pacifics will be designed to operate at a speed of about 74 m.p.h. and to work on grades of 0.5 and 0.6 per cent. The Mikado locomotives are to be built for speeds of about 56 m.p.h. and for grades of from one to 1.2 per cent. The axle load of these locomotives will be limited to about 41,000 lb. as that is the limit required by the Minister of Public Works and Transports of France. This limit is set on account of the fact that many of the bridges in France are too weak to carry a higher wheel load, and as a general rule there are two less ties used per rail than is the practice in America.

The adoption of the two standard types of locomotives does not mean, however, that other locomotives will not be built, and it is expected that other locomotives will be designed and built by any of the four roads to meet any special conditions they may have. However, as many details as possible will be the same as those used on locomotives built to the standard designs.

There are five standard designs of cars to be built; two types of box cars, with and without screw brakes; two types of coal cars, with and without screw brakes, and flat cars with no screw brakes. The question of power brakes is under consideration. It is the desire of progressive engineers in France to have continuously braked freight trains, but whether this will be permitted with the excessive amount of slack between the cars of the present day French freight train with the type of coupling in use at present, remains to be seen.

Several engineers have expressed a strong desire to use automatic couplers, but with the present screw type of coupler generally used in France, the introduction of the automatic coupler would entail numerous difficulties, and until some design of automatic coupler is made which will readily interchange with the screw type of coupling now used, but little will be done in this respect.

The work on standard passenger cars has not progressed to the same extent as in the freight cars. They will, however, be of all-steel construction. This type of construction is not new to French railways. The Paris-Orleans has built nothing but steel passenger equipment for years, and, in fact, some of our first steel equipment was patterned after the Paris-Orleans designs.

The work in Belgium has not developed to the extent that it has in France, but the conditions in Belgium are such that until the disposition of the German equipment running on Belgian rails under the terms of the Armistice is known, no definite plans will be formulated. The Belgians, in addition to their varied stock of power, have had to cope with the added inconvenience of some 40 to 45 designs of German locomotives and innumerable designs of German cars. This has accentuated the need of equipment of more uniform design. It is the desire of the State railways there eventually to return the German equipment and receive indemnities with which to buy new equipment. If this is granted—it is doubtful if it will be—some plan of standardization will be formulated as a vast amount of equipment will have to be built to replace the equipment which has been destroyed during the war.

EQUATED TONNAGE AND FUEL CONSUMPTION *

BY R. N. BEGIEN
Federal Manager, Baltimore & Ohio, Western Lines

Equated tonnage has a certain relation to fuel consumption. However, this relation is established through the medium of the trainload. The fuel consumption per gross ton mile decreases as the trainload increases, provided the speed of the movement does not suffer to such an extent as to increase the time on the road materially. The purpose of equated tonnage is to secure uniform loading of power, regardless of the kind of equipment or number of cars involved. It is a well known fact that an empty car has a much higher resistance per ton of weight than a loaded car. For example, a 20-ton empty will show a resistance in the neighborhood of eight pounds per ton of weight, or 160 lb. total resistance to traction on a level. On the other hand a 70-ton car shows a resistance of approximately four pounds per ton of weight, or 280 lb. of resistance to traction on a level. These figures are approximate, but for practical use are correct. Of course many other features enter into the question, such as temperature, wind, rate of grade, curvature, type of car, etc.

In order to make practical standards which can be placed in the hands of yardmasters, it is necessary to use certain adjustments in building up trains, and to modify them as is necessary in the judgment of the chief train despatcher to suit conditions under which the operation is conducted. If a locomotive is able to produce 30,000 lb. of effective tractive effort behind the tender at rating speed, the train should have a combined resistance of 30,000 lb., irrespective of the character of the cars, and in order to accomplish this a certain arbitrary adjustment is added to the weight of each car, and the effect of this arbitrary adjustment is to automatically compensate the different weights of cars. This adjustment varies with the rate of grade, being about 15 tons per car on a 0.3 per cent grade, and about two tons per car on a 2½ per cent grade.

Building up a train tonnage, composed of the dead weights of cars, plus an adjustment, so that the combined resistance of the cars is equal to the effective tractive power behind the tender, gives a tonnage which is known as an equated tonnage. The object is to secure uniformity of rating in order that the trains will always have a rated tonnage, irrespective of the kind of cars. There are a number of different ways of applying this principle, but unless some kind of equated tonnage is used it is not possible to rate trains with any degree of accuracy.

It is safe to say that any road which has not used the equated tonnage system, and which has through freight to haul, has not built up its trainload to the best possible advantage. Full trainload at uniform speed spells efficiency in fuel consumption, and the relation of equated tonnage to fuel consumption is very clearly evidenced through the trainload.

Proper train loading contemplates each locomotive handling the maximum trainload which it can move on the ruling grade at the economic speed. At such speed the locomotive is working most efficiently. An increased speed, which may be brought about by reduced trainload, will result in inefficient locomotive performance, while a reduced speed, brought about by overloading, will produce the same result. With all trains moving at the economic speed, the locomotives operating at maximum effort and hauling the uniform trains under these conditions, the fuel consumption, when measured on the ton-mileage basis, will be the minimum obtainable.

*Abstract of paper presented before the International Railway Fuel Association convention at Chicago, May 19-22, 1819.

Mechanical Stoking of Locomotives*

Factors Determining Necessity of Applying Stokers; Operating Results Secured by Stoker Firing

BY W. S. BARTHOLOMEW
President, Locomotive Stoker Company

THE FIRING OF MODERN LOCOMOTIVES by mechanical means could properly be separated into four distinct subjects: First, the stokers themselves; second, the locomotives to which they are applied; third, the particular reasons which lead up to any given application, and fourth, the results which were achieved by such application. I assume that you are familiar with all of the stokers which are now being applied to locomotives and shall begin with the second subject.

All locomotives do not require stokers. Locomotives that can be hand-fired to maximum capacity through sustained periods do not require stokers. Locomotives which are of such size as to come within the specifications of those which are regularly being equipped with stokers, but which are not operated beyond the limits of hand-firing, do not need stokers. These statements must lead to the conclusion that only locomotives which are of such size as to bring them regularly beyond the limits of hand-firing, or locomotives of smaller size but which are regularly operated beyond the limits of hand-firing, require stokers. This must mean that we do not need stokers to do a hand-firing job and that the stoker job cannot be done by hand. This means also that stoker-firing and hand-firing are not directly comparable. Up to the present time, no locomotives have been equipped with stokers which do not need them.

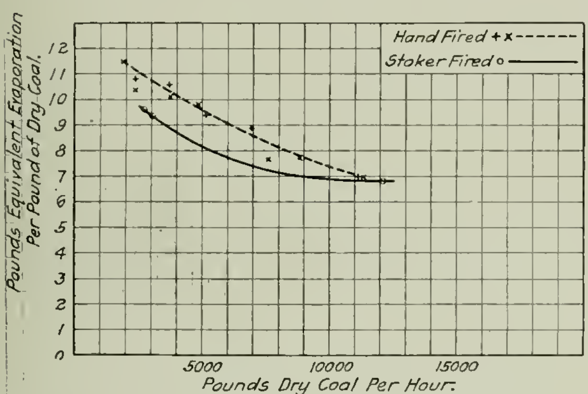


Fig. 1—Comparative Evaporation, Hand and Stoker Firing

LOCOMOTIVES WHICH REQUIRE STOKERS

These statements must bring up immediately the question as to whether such a definite line can be drawn between locomotives which do not need stokers and those to which they could be applied to advantage. To show you that a definite line can be drawn as to locomotives which can be hand-fired through sustained periods and those which cannot, my own convictions are that no locomotive really requires a stoker that does not weigh approximately 200,000 lb. on drivers, have a calculated tractive power of 50,000 lb. or over, a grate area of 60 sq. ft. or over, and a coal consumption through sustained periods of 4,000 lb. or more per hour.

The commercial application of Mechanical Stokers to locomotives really began in 1910. One of the first important stoker applications was made to five very large locomotives which were designed and built originally to be equipped with stokers. This is especially significant in that, in the main practically all stoker applications have been made to date to locomotives without requiring any general modification in the conventional locomotive design. This application was made on a Chicago, Burlington & Quincy M-2 Santa Fe type locomotive which included in its original specifications such details of design as would permit the application of the Barnum under-feed stoker.

The particular point of interest about this locomotive is that in designing such a locomotive it was realized that to put it in service with a tractive effort of about 72,500 lb., a weight on drivers of over 300,000 lb., and with a grate area of 88 sq. ft. would call for a coal consumption beyond the possibilities of hand-firing.

Five of these locomotives were built in the year 1911 and equipped with stokers, which later proved inadequate in capacity for the requirements and were removed, and the locomotives were put in service in such districts as would permit them to be hand-fired. It was found, however, that they could be hand-fired only by reducing the grate area

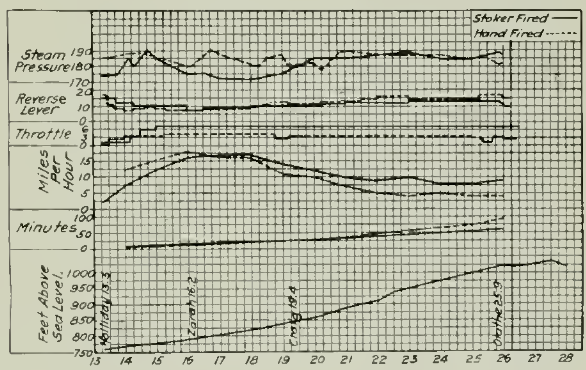


Fig. 2—Hand and Stoker-Fired Tests on 13-Mile Grade

about 25 per cent by blocking off with fire-brick. These circumstances plainly indicate that on such a locomotive a differential is immediately established between hand-firing, and stoker-firing of at least 25 per cent in capacity. A very gratifying development of this particular situation has been that other stokers were later applied to these locomotives with such success that 60 more have been purchased.

The decision reached by the Burlington as to necessity for a stoker on a Santa Fe type locomotive of this size has practically set the pattern for all such locomotives of this type built. During the past five years over 95 per cent of all Santa Fe type locomotives built for coal-burning service have been equipped with mechanical stokers.

STOKERS INCREASE CAPACITY OF LOCOMOTIVES

Another very early important stoker installation beginning in 1912 was made by the Norfolk & Western on a large number of Mallet locomotives. This installation probably rep-

*Abstract of a paper presented before the Western Railway Club.

resents the most marked increase in revenue tons per train that has been accomplished by any stoker installation made so far. To make a concrete illustration the tonnage rating for the 12-wheel locomotives in service on the Norfolk & Western between Portsmouth, Ohio, and Columbus, which were standard for that division before the advent of the Mallet locomotives was 3,000 tons per train for one Class M-2 12-wheel locomotive, or 6,000 tons for a double-header, whereas when the Mallets were tried out and rated on that division it was found that one of these locomotives could haul 6,000 tons between those two points in practically the same time that one of the smaller locomotives could haul 3,000 tons or two of them could haul 6,000 tons.

It was also discovered that the coal consumption of one of the Mallets was approximately one and one-half times one of the 12-wheelers, which, with twice the tonnage, would make an immediate saving of 25 per cent in coal consumption for any given number of total gross tons per mile.

There is current gossip to the effect that the application of stokers to locomotives means more coal consumption, which, of course, it does from one point of view, as one of the main purposes of the stoker is to make it possible to burn more coal per locomotive mile or per locomotive hour than would be possible by hand-firing. The benefits, however, from such increased coal consumption are such as to make the proposition attractive from every point of view as "movement of tons per day" over any given piece of track is the most important consideration in railroad operation. You only need to refer to the annual reports of the Norfolk & Western for the past five or six years to see what has been accomplished in this direction through the use of larger locomotives equipped with stokers.

The stoker fired H-2 and H-4 Mallet locomotives on the Chesapeake & Ohio have accomplished very similar results

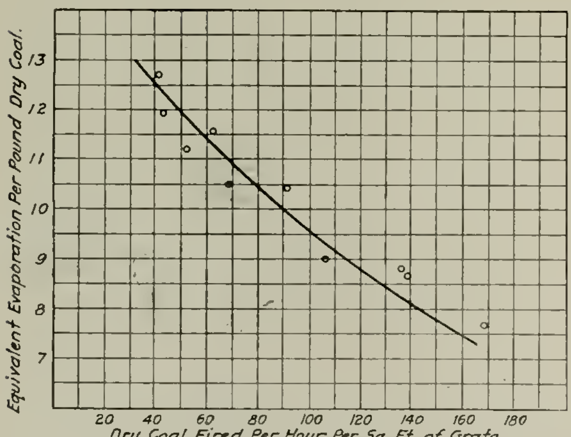


Fig. 3—Effect of Rate of Firing on Equivalent Evaporation

in increased tons per train and the use of over 300 such Mallets in freight service is a further tribute to the value of the mechanical stoker in the assistance it renders in putting into service such locomotives which regularly are operated with a coal consumption beyond the limits of hand-firing.

It is not a question of the pounds of water evaporated per pound of coal altogether, although these particular locomotives show an evaporation, stoker-fired, that comes well within the limits of anything that is regularly accomplished on smaller hand-fired locomotives which are operated anywhere near maximum capacity.

EARLY INSTALLATION OF STOKERS

About the time these Mallets were put in service on the Chesapeake & Ohio 50 heavy Mikados with a tractive effort of approximately 60,000 lbs. were purchased and have now been successfully stoker-fired for over six years. There has been established a differential of 25 per cent between hand-fired and stoker fired tonnage rating on the division where these locomotives are operated. The rating between Russell, Kentucky, and Silver Grove, is 6,000 tons stoker-fired and 4,800 tons hand-fired.

Another very early and important stoker installation was made by the Virginian on somewhat larger Mallet locomotives. These early stoker installations had to do with coal traffic, which, of course, is a low-grade commodity from a freight revenue point of view and the earnings are in more direct relation to the tons per train than is the case with other traffic. The operation of these locomotives in the coal traffic

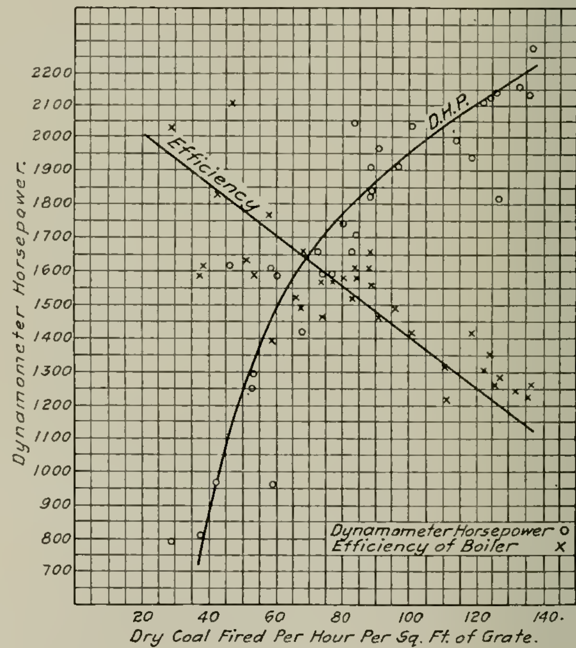


Fig. 4—Boiler Efficiency as Related to Horsepower Chart

on the Virginian has been so successful that special track, special cars, special coal-handling devices at the docks and still larger locomotives have been built to make it possible to increase the gross tons per train still further.

The specifications for the stokers for the Virginian 2-10-10-2 Mallets called for an ultimate coal-delivering capacity of 15,000 lb. per hour as a possibility, and in actual service it is not unusual to have a coal consumption of five tons every 60 min.

The locomotives referred to thus far have all had a calculated tractive effort of more than 60,000 lb. However, a Baltimore & Ohio Mikado which has a calculated tractive effort of only 54,000 lb. represents the largest installation of mechanical stokers to any one type of locomotives up to the present time. The Baltimore & Ohio has over 400 of one design stoker-fired and this locomotive really established the point where the Railroad Administration began the application of stokers to the standard locomotives.

This locomotive not only represents a very important early stoker application as to number of locomotives equipped, there having been 50 of these locomotives equipped as early as 1911, but it also represents definitely the point at which we believe the application of stokers should begin to both new and old locomotives.

STOKERS PROVE ADVANTAGEOUS ON SMALL LOCOMOTIVES

The reason which led the Baltimore & Ohio to apply stokers to such a large number of these locomotives as early as 1911 had largely to do with the fact that the bridges, track, and sidings on the Baltimore & Ohio were such that a locomotive with a heavier axle load than 55,000 lb. could not be operated at many points on the Baltimore & Ohio system. The traffic conditions, however, especially between Cumberland, Md., and Martinsburg, W. Va., which is the throat of the system between the Lines East and Lines West, were such as to require a maximum tonnage movement for long periods of the year to avoid congestion.

At the time the first 50 of these locomotives were put in service on the Cumberland Division 48 maximum tonnage eastbound drag freight trains were operated daily. It will be immediately appreciated that both time and maximum tonnage per train were of immense importance under such stress of traffic conditions. Immediately upon putting into service the stoker-fired Mikados referred to on this division, where a large number of duplicate locomotives were already in operation hand fired, the operating department began to load down the stoker-fired locomotives with heavier tonnage than the hand-fired until within six months after they were put in operation more than 500 tons per train were regularly added to the stoker-fired locomotives over and above the tonnage given to the same locomotives hand-fired.

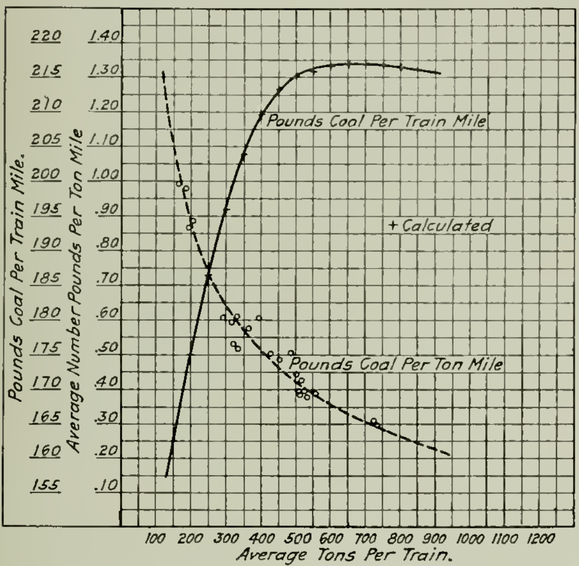


Fig. 5—Relation Between Coal per Train-Mile and Tons per Train

The Baltimore & Ohio at this time owned 160 of these locomotives without stokers and 50 stoker-fired. Since then they have purchased over 300 of these locomotives equipped with stokers which are now in daily service over all parts of the system.

To haul the traffic under the conditions just outlined between Cumberland, Maryland, and Martinsburg, W. Va., an average coal consumption per hour of 6,500 lb. was not unusual for the entire running time between division points, which will readily explain why the stokers have been so successful on the Baltimore & Ohio even on this comparatively small power. When the United States Railroad Administration came to place orders for a large number of locomotives, which included over 600 of this particular type and size, they were also equipped with mechanical stokers which made it possible to use them in such service as I have just described.

The Pennsylvania has a Decapod type locomotive which weighs over 300,000 lb. on drivers; carries 250 lb. steam pressure and has a calculated tractive effort of nearly 90,000 lb. It is of special interest to know that this locomotive was originally designed to be hand-fired and the first one constructed was put in service without a stoker for the reason that it was intended to operate these locomotives only within the limits of coal consumption which could be fired by hand through sustained periods. Over 100 of these locomotives have been built to date and not only the first one which was originally put into service hand-fired, but all of the others have been equipped with mechanical stokers.

COMPARATIVE FUEL ECONOMY OF HAND AND STOKER FIRING

The reason which led up to this application was entirely one of capacity rather than what is ordinarily referred to as economy. The first locomotive originally hand-fired was equipped with a mechanical stoker, and extensive comparative tests made to determine the relative economy of stoker-firing and hand-firing. The chart shown in Fig. 1 indicates the result secured, and confirms the statement that a stoker is not needed to do a job which can be done by hand, nor can the stoker job be done by hand-firing.

It will be noted that within the limits of hand-firing, namely, below 5,000 lb. of coal consumption per hour, there was a slight difference in economy shown in favor of hand-firing. It will be further noted, however, that when the rate of firing in the different tests was increased to where the stoker became a necessity that no difference in economy in favor of hand-firing occurred, and, as a matter of fact, while the hand-firing was of the most expert nature, the capacity was not reached by hand that was easily obtained with the stoker.

A most interesting situation was developed in connection with putting these locomotives into service under actual operating conditions, which was fully to be expected from the results shown in this graphic chart. One of these locomotives was put in service with its rated tonnage on a certain division and hand-fired, the coal consumption noted, and other records made of the performance. Very shortly thereafter another test was made with the same locomotive over the same division with similar tonnage, all conditions being duplicated as far as possible except that the locomotive was stoker-fired instead of hand-fired. The coal consumption, the water evaporated and the horse-power hours developed over the division were almost identical in each instance.

FUEL ECONOMY SACRIFICED FOR INCREASED CAPACITY

There has been much discussion in connection with the application of mechanical stokers to locomotives as to the comparative economy between stoker-firing and hand-firing, and I wish to refer again to my earlier statement that stoker-firing and hand-firing are not directly comparable. The reason for this has really nothing to do with the stokers themselves, but is due to the different points at which the locomotive is worked with hand-firing as compared with stoker-firing.

The significant fact in connection with the comparative tests, however, is that it required 11 hrs. to develop the necessary horsepower-hours to take the train over the division hand-fired, whereas, practically the same horsepower-hours were developed and the train taken over the division in 7 hrs. when stoker-fired. In other words, taking a maximum hand-firing capacity of approximately 5,000 lb. per hr. as a gage of the limit of hand-firing, this would mean that by firing 8,000 lb. per hr. into the fire-box of the same locomotive with the stoker the same number of horsepower-hours could be developed in 7 hrs. that it took 11 hrs. to do by hand.

From the traffic point of view I believe there would be no argument if there were no other considerations than this marked difference in time saved by developing more horsepower with the stoker on this very large locomotive than was possible to do by hand even with the same measure of economy. One of our engineers estimated the difference in results, however, from another point of view; namely, reducing the tonnage to a point where the train could be handled over the division by hand-firing in seven hours to compare with the heavier train stoker-fired over the same division in seven hours. A very conservative estimate would indicate that on the basis of seven mills per revenue ton income per mile the locomotive would pay for itself in less than 100 trips by being stoker-fired and hauling the heavier tonnage. There has not come to my attention in all of our stoker experience a better example of the real purpose of the stoker than its application to this large lot of locomotives.

SPECIAL SERVICE CONDITIONS MAKE STOKERS NECESSARY

In marked contrast to these large locomotives is a small Consolidation locomotive in service on the El Paso & Southwestern to 21 of which stokers have been applied and which are the smallest locomotives to receive stokers to date so far as I know. They have a tractive effort of but 47,000 lb. The considerations, however, leading up to the stoker application had nothing to do with capacity or economy. The climatic conditions in the desert country during a large part of the year which made it almost impossible to secure firemen to operate such locomotives at all was the main factor so that it was not in any sense inconsistent to apply stokers even to these small locomotives in order to operate them, although I understand the hauling capacity has been actually increased by the stoker application, which it would be very natural to expect under the circumstances.

We come now to a consideration of some of the results which have been achieved by the stoker applications that have been made in different parts of the country and on different locomotives up to this time.

The data shown in Table I. were obtained by the Atchison, Topeka & Santa Fe in tests of a Mikado locomotive having approximately 60,000 lb. tractive effort. This tabulation will serve to bring out some points with regard to coal consumption per hour as related to the hauling capacity of a locomotive of this kind when it is desired to increase the revenue tons per train. The significant points about this tabulation are that the coal consumption per hour is fairly representative of the difference between the maximum possibilities of hand-firing and the ordinary range of operation when stoker-fired.

Table I—Comparative Test Data, Hand and Stoker Firing

Test No.	Tonnage	Cars	Loads	Empties	Running time Hr. Min.	Coal used, lbs.	Evaporation Per lb. coal	1,000-ton miles	Coal per 1,000 T. M.	Coal per hour	Coal per sq. ft. gr. per hour	Average steam pressure	Hand or stoker
7	2,579	65	63	2	6:42	35,000	5.62	281.9	124.2	5,224	78.2	184.3	H
9	2,713	69	60	9	5:48	35,500	5.58	296.6	119.8	6,121	91.3	178.8	S
11	2,849	71	67	4	6:34	46,600	4.75	311.4	149.7	7,096	106.2	175.7	S
13	2,835	74	58	16	5:40	38,083	5.39	306.8	124.3	6,721	100.6	177.0	S
15	2,848	75	73	2	5:38	41,076	4.91	300.1	136.8	7,403	110.8	185.9	S
17	2,896	56	56	0	5:53	43,300	4.73	312.8	138.4	7,360	110.7	185.8	S
19	2,872	71	66	5	6:31	44,890	4.55	310.2	144.7	6,888	103.1	167.5	S
21	2,869	65	65	0	5:28	35,600	4.76	313.6	113.5	6,512	97.7	183.6	S
23	3,059	73	72	1	6:04	37,350	5.03	334.3	111.7	6,156	92.0	179.4	S
25	3,061	65	56	9	6:16	38,250	5.57	334.6	114.3	6,203	92.9	181.2	S
27	2,887	61	57	4	5:27	32,300	5.62	314.6	102.7	5,927	88.7	187.7	S

It will be noted that the coal consumption per hour on hand-fired run No. 7 was 5,224 lb. per hr. or 78.2 lb. of coal per square foot of grate area per hour. This brought a coal consumption per thousand ton miles of 124.2 lb. and I believe represents maximum hand-firing possibilities. All of the ten other trips shown on this tabulation show a coal consumption of from 6,000 lb. to 7,400 lb. per hour, and taking the high and low coal consumption per thousand ton miles, the average happens to be for the ten trips almost to a fraction the same as the coal consumption per thousand ton miles for the hand-fired trip, the larger percentage of the stoker-fired trips being below the hand-fired trips in coal per one thousand ton miles. A maximum increase of nearly 500 tons per train was secured on some of the stoker-fired trips, and it will also be noted that on no stoker-fired trip was the actual running time as long as on the hand-fired trip.

SPEED ON GRADES INCREASED BY STOKERS

At the end of one of the runs I took occasion to go into the train despatcher's office, look over his operating sheet, and make inquiries as to the time required by all of the freight

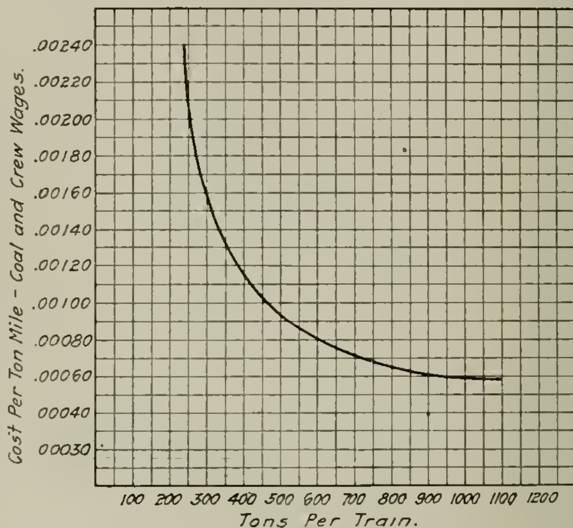


Fig. 6—Cost of Coal and Crew Wages as Related to Tons per Train

trains westbound on that day to cover a 13-mile and an 8-mile 6/10 per cent grade, which grades are the limiting factor on that particular division. The result of that inquiry is shown in Table II.

The 2,900 tons taken up the 13-mile grade in 50½ min. has illustrated better than any description that could otherwise be given the real purpose of the application of a stoker to a locomotive like the Mikado which hauled this train as compared with other similar locomotives hauling from 500 to 1,000 less tons in longer time up the same grade hand-fired. It is true that more coal was consumed in the 50½ min. hauling 2,900 tons in that time up the 13-mile grade than would have been the case if the locomotive had been operated at a less cut-off, less throttle and consequently less speed, but the fact remains that to get maximum tonnage over the division in the minimum amount of time requires this kind of locomotive performance. In addition to illustrating the main purpose of the stoker it also shows why it is quite often stated that from the point of view of water evaporated per pound of coal the coal consumed per locomotive mile is more when stoker-fired than might be the case when such a locomotive was hand-fired under less strenuous conditions.

Table II—Time on Ruling Grades

Engine No.	Gross tons	13-Mile grade 31.68 feet. Per mile	8-Mile grade 31.68 feet. Per mile
3211	1,800	61 min.	30 min.
3202	2,180	48 min.	27 min.
3207	1,950	63 min.	25 min.
3209	2,900	50½ min.	31 min.
3206	2,120	75 min.	32 min.
3200	1,945	46 min.	31 min.
3121	2,000	58 min.	....
3192	2,285	82 min.	....
3193	1,850	54 min.	....

In order to get a more direct comparison of the possibility of hand-firing and stoker-firing with the tonnage rating such as shown on the stoker-fired trips of the tabulation, and also to compare the performance on the 13-mile grade with the 2,900-ton train, a hand-fired trip was made over the division with what might be called stoker tonnage. Fig. 2 is a graphic chart showing the comparative performance between a hand-fired and a stoker-fired trip. It will be noted that the locomotive was worked at a point stoker-fired which was not possible on the hand-fired trip, the result being that 31 min. more time was required to take the train with stoker tonnage up the 13-mile grade with hand-firing than with stoker-firing.

There are additional points of interest which cannot be plotted by curves namely, that on the particular day on which the hand-fired run was made, the traffic was exceptionally heavy and one manifest and one drag freight train were immediately behind the hand-fired train on the 13-mile grade which would not have been the case had that particular trip been stoker-fired and the 31 min. less time on the hill.

The diagram shown in Fig. 3 illustrates the rate of evaporation as related to the rate at which dry coal is fired per square foot of grate area per hour. The tests indicated on this diagram were all hand-fired so that this drop in the evaporation rate had nothing whatever to do with hand-firing as compared with stoker-firing, but must be definitely borne in mind as usually being related to the price we must pay when we stoker-fire a locomotive to its maximum capacity; in other words, get a coal consumption rate up to the point shown on some of the tabulations.

The next diagram, Fig. 4, illustrates the point even better. The many tests plotted on this diagram were practically all hand-fired, but no better illustration could be prepared to illustrate the price we must pay for operating the modern locomotive to its maximum capacity.

There are many locomotives being operated at the point where less horsepower output is being secured in order to keep the evaporation of water per pound of coal up to a point shown in the left-hand section of this diagram, but on the other hand there are very many more locomotives being operated under the conditions shown on the right-hand section of this diagram and, of course, from the stoker manufacturers' point of view, this is really where we expect a large locomotive to be operated if equipped with a stoker.

The reason that more locomotives are operated at their highest possible horsepower output, notwithstanding the fact that this brings a decrease in so-called boiler efficiency, is, of course, because a very satisfactory return is secured on the price paid for such operation. This price is represented in the cost of coal per locomotive mile, and the returns on the investment are represented in the reduced cost of coal per ton mile brought about by the increase in revenue tons per train hauled by the locomotive when operated at its maximum horsepower output. The curves in Fig. 5 illustrate the relation between the increased cost of coal per locomotive mile and the decreased cost of coal per ton in the heavier train.

This decrease in cost per ton mile is not altogether confined to coal alone as the increased revenue tons per train made possible by the maximum horsepower output of the locomotive is directly related to crew wages as well. Fig. 6 illustrates the decrease in the cost per ton mile of both coal and crew wages combined, and further illustrates why it is desirable to operate freight locomotives to maximum capacity even at an increased cost of coal per locomotive mile.

I have said nothing so far in this paper about the stoker doing the manual work of the fireman or relieving him from the suffering incident to the heat of the fire-box due to opening the fire door when hand-firing, as it has been my endeavor to illustrate the returns which are being secured on the large investment which has been made in mechanical stokers for locomotives during the past six or eight years. It goes without saying, however, that there are many other advantages in the application of stokers to locomotives. One of these is, of course, the relief of the firemen, making the position of locomotive fireman more attractive and, therefore, making it possible not only more readily to secure men for this work, but also to select those men who are particularly qualified later to become locomotive engineers rather than to consider only their physical stamina.

I have tried to be very frank in my statements and have in no sense endeavored to have you reach a conclusion that it is not necessary to pay a certain price for the use of the stokers on locomotives such as have been equipped with them. On the other hand, it is very plain that whatever the price that it is necessary to pay it brings a most satisfactory return from every point of view. Objection can be raised against the stokers, of course, just as objections can be raised to many of the other modern labor-saving and capacity-increasing devices and features which have been added to locomotives in recent years to enable us to travel the avenues of economy which have brought such large returns in present-day railroad operation. The mark which we are aiming at in the application of mechanical stokers to locomotives is mainly one of capacity; and in the sense that the word economy is ordinarily used, we must conclude that the kind of locomotive capacity which I have pointed out must take precedence over economy for large modern locomotives.

It is significant that the cost of coal is after all a comparatively small part of the total operating expenses, and as the economies that occur from any increase in revenue tons per train mile have a much larger influence upon the net annual earnings of any given railroad company than does any variation either up or down of the cost of total coal used per annum by that railroad. It follows that what must be accomplished first and above all other things is to increase the revenue tons per train mile.

LOCOMOTIVE CONDITIONS IN ENGLAND

The condition of the locomotives of the London, Brighton & South Coast Railway, which is considered indicative of the general conditions throughout the country, was made a matter of comment in the London Post of July 1.

It is reported that out of about 600 locomotives there are 166 awaiting repairs. At the same time the traffic condition of this road has increased from 80,000,000 passengers a year before the war to 100,000,000 passengers a year at the present time, or an increase of 25 per cent. This is being handled with a 25 per cent reduction in service and a 20 per cent reduction in force. This company released 5,263 men or nearly 33 per cent of its total force for war service, out of which 2,279 have returned. A large number of those who have not as yet come back are men of technical skill, and this is largely responsible for the retarded repairs. Also many of the skilled workmen have left the railroad to go to the ship yards. This is particularly the case with the boilermakers. At the repair shops at Brighton in July, 1914, there were 70 locomotives under repair with only seven awaiting shop. In May of this year there were 107 locomotives under repair with 59 awaiting shop. The situation is so bad that this company has found it necessary to have locomotives repaired in contract shops. One shop promised to repair two engines a month, beginning with January of this year, but as yet none have been delivered. In addition to the shortage of men, a reduction of working hours has accentuated the difficulty. With the present situation the company does not expect to get back to pre-war conditions for at least another twelve months.

Considerable pressure has been brought to bear for a reduction in fares, but if this were done, traffic would increase beyond the capacity of the company to handle it. The increase in the cost of wages and materials is more than 50 per cent of pre-war conditions.

Railroad Administration News

Shop Men's Wage Negotiations Reach Critical Stage; Standard Freight Cars Being Put in Service

The railroad Administration has revised the instructions issued early last year that new locomotives being delivered by the builders be sent under steam and hauling tonnage and the regional directors have been given discretion to decide whether new locomotives shall be sent dead in trains or under steam with a load, upon notifying the mechanical department. The question will depend on whether it will be practically useful to use the new locomotives for hauling tonnage that is going in the direction of the locomotives. The use of such locomotives when moving under steam will be accepted as full payment for transportation charges.

Shopmen to Take Strike Vote

The 1919 cycle of demands on the Railroad Administration for increased wages has reached a critical stage. Committees representing the various shop craft unions federated under the organization of the Railway Employees' Department of the American Federation of Labor, that presented demands to the director general in January for a wage increase from 68 to 85 cents an hour for the principal classes of craftsmen, as well as increases for helpers and differentials for various classes of special work, were in Washington all of the last week in July conferring with the Railroad Administration officials and threatening strikes unless a favorable decision was forthcoming soon. The unions also demanded the issuance of an order prescribing uniform rules and working conditions. Both propositions have been under investigation for several months by the Board of Wages and Working Conditions, which submitted its recommendations on both to Director General Hines.

On August 1, President Wilson, on the representations of Director General Hines, urged upon Congress the necessity of passing speedy legislation providing for the creation of a tribunal to investigate and determine all questions concerning the wages of railroad employees, but excluding rules and working conditions, and also making its decisions mandatory upon the Interstate Commerce Commission to provide any increase in rates necessary to cover any recommended increases in wages. In his letter to the President, the director general further recommended that Congress be asked to provide in any such legislation that any increases in railroad wages which may be made by the tribunal constituted for that purpose, be made effective as of August 1, 1919, so that the delay incident to the creation of such a tribunal will not be prejudicial to the employees. In his letters to Senator Cummins and Representative Esch, the President expressed his approval of this recommendation.

Prior to this apparent attempt on the part of the Railroad Administration to shift the responsibility of meeting the wage increase demands of the various classes of employees, the shopmen had already been displaying a great deal of impatience because of the delay in passing on their demands and several local strikes had been called.

The labor organizations, generally, apparently did not take kindly to Mr. Hines' proposal and the shop organizations particularly were aroused by the suggestion that any increases be made effective as of August 1 because they had demanded that their increase be made retroactive to January 1, 1919. B. M. Jewell, acting president of the Railway Employees' Department of the American Federation of Labor, announced on August 2 that it had been decided to call for a strike vote, returnable by August 24, of the approximately 500,000 shop employees involved.

Acting on behalf of the six shop crafts a committee of 100, of which Mr. Jewell as chairman presented to the director general on January 7 a request for a minimum of 85 cents an hour for mechanics, an increase of 17 cents; a minimum of 60 cents for helpers, an increase of 15 cents; an increase of 10 cents per hour for apprentices and various differentials for special classes of work. On February 8 the question was referred to the Board of Wages and Working Conditions, during March and April hearings were held by the board, and on July 16 the board made its divided report to the director general. During this period the board was also giving consideration to a demand by the shop crafts for a national agreement covering rules and working conditions, to be effective on all roads under federal control regardless of whether they had previously had contracts with the unions.

These were considered by committees representing the employees and the regional directors, which submitted a report to the board and the board made its recommendation to the director general on July 16.

During June and July several local shop strikes were called by way of protest against the delay in passing on these two matters, but they were settled. Beginning on July 28 the committee of 100 began a series of conferences with the director general demanding a decision by August 1. The unions on the southeastern roads had definitely decided to strike on that date unless their demands were granted. On July 30 Mr. Hines advised the committee he would be glad to enter into the agreement covering rules and working conditions, and promised to give a decision on the wage question later. Mr. Jewell then wired the various local organizations that they had gained one point sought and instructing them that there must be no stoppages of work pending the conclusion of the negotiations. This was not sufficient to hold the men in check, however, and the shop men walked out in various parts of the country on August 1, the number increasing on the following days. The dissatisfaction was increased on that date, when in lieu of a decision on the wage question Mr. Hines read to the committee his letter to the President proposing a special wage tribunal. Meanwhile the negotiations as to the rules and working conditions have been temporarily set aside.

"We shall continue to endeavor to settle the demands by negotiation with the Railroad Administration pending receipt of the strike vote," said Mr. Jewell. "That will, when taken, simply center the power for calling a strike in the hands of the committee. The first effect will probably be the ending of the present strike, which has taken out a considerable number of men over various sections of the country who have been impatient of the long delay. Their walkouts have been unauthorized, but we expect they will return when they see that the organizations intend action in a united fashion."

Approximately 30,000 shopmen in Chicago and 100,000 men in the Chicago district were reported to have left their work at 10 a. m. on August 1 and approximately 35,000 men on 16 railways in the Southeast took similar action. This strike came at a particularly unfortunate time because the Railroad Administration has been bending every effort to put its equipment in condition to meet the demands of the heavy grain traffic. Shopmen in Boston, Philadelphia and

Denver were also reported to have gone out, and the strike spread somewhat on the following day. By August 4 leaders of the shopmen in Chicago declared that 50,000 men were out throughout the country. The shop employees of the Southern Railway at Alexandria, Va., a stragetic location for making an impression on Congress, were among the first to walk out and they were followed on Saturday by the employees at Potomac yard, and on Monday by those at the Washington terminal.

On August 4, B. M. Jewell and other members of the shopmen's committee called on the President at the White House.

STANDARD FREIGHT CARS BEING PUT IN SERVICE

Because of the favorable progress being made in working out the plan for financing the standard equipment ordered by the Railroad Administration through a national equipment corporation, and because of the growing demand for cars, the Railroad Administration has arranged to put into service at once all of the standard freight cars that have been built and that have been kept in storage on railroad tracks near the plants of the builders because of the failure of many of the railroads to accept the allocation of the cars as made by the Railroad Administration. This will put into service several thousand cars, including a large proportion of coal cars, as fast as the cars can be stencilled with the initials of the roads to which they have been allocated. The cars that have been built but not accepted have been paid for by the Railroad Administration as they have been completed, with a deduction representing the cost of stencilling and marking, and the storage has been at the expense of the Railroad Administratoin. It is understood that the cars are being placed in service without opposition on the part of the railroad companies, many of whom formerly protested against the allocations, largely on the ground of their inability to finance them, because the Association of Railway Executives has received assurances from roads representing 70 per cent of the equipment that they will participate in the new equipment trust plan.

Reports of scattering local car shortages are coming from various parts of the country, but while there is understood to be a very large number of surplus cars in the country as a whole the Railroad Administration is unwilling to give out the figures. On June 1 there was a surplus of about 300,000 cars, and it is believed this was considerably reduced by July 1 and still more reduced during July, but the number of freight cars reported as unserviceable for the month of June was nearly 200,000, or 8.1 per cent, although a large number were so reported merely because they were not grain tight and would require little work to put them in shape. Orders were issued late in June to increase the car repair forces that had been reduced earlier in the year in an effort to put the equipment in condition for the summer and fall traffic.

NUMBER OF WOMEN EMPLOYEES REDUCED

The total number of women employed under the United States Railroad Administration reached the highwater mark on October 1, 1918. At that time there were on the rolls 101,785 female employees. The number of women employed on April 1, 1919, shows a decrease of 14.3 per cent as compared with January 1, 1919.

Statistics compiled by the Women's Service Section, giving the number of women employed and the character of their employment since the roads came under federal control have been made public by the director general.

On January 1 of the present year there were on the rolls of the railroads 99,694 women employees, while on April 1 the number had dropped to 85,393. This was due chiefly to the reduction of labor force which occurred in February and March. It was also partly due to the return of men from military service who were reinstated by the railroads.

The statistics show that more than 5,000 women were employed in railroad shops and more than 1,000 in roundhouse work. The latter included, among others, turntable operators and engine wipers. On October 1, 1918, there were 6 women employed as blacksmiths, helpers and apprentices, while a large number of others worked as boilermakers, coppersmiths, electricians and machinists.

The report shows that, considered from the point of view of occupation, the greatest reduction of women employees has taken place in round-houses and shops. Their work in these places was in many cases found unsatisfactory, there being too much heavy physical labor involved.

COST OF FREIGHT TRAIN AND LOCOMOTIVE SERVICE DECREASING

The total cost of freight train service, including locomotive service, continues to show a steady decrease each month as compared with preceding months, although increases as compared with last year, according to the monthly report compiled by the Operating Statistics Section. The combined averages for all regions and the comparative figures for last year and for April, March and February, this year are as follows:

	May, 1919	May, 1918
Cost of locomotive service per locomotive mile	110.3	97.8
Locomotive repairs	37.9	31.3
Enginehouse expenses	9.0	6.6
Train enginemen	19.1	18.1
Locomotive fuel	40.7	38.9
Other locomotive supplies	3.5	2.8
Cost of train service per train mile	156.8	141.0
Locomotive repairs / Enginehouse expenses	53.4	43.7
Locomotive fuel	46.3	44.9
Other locomotive supplies	3.9	3.3
Train enginemen	21.8	20.9
Trainmen	25.1	23.7
Train supplies and expenses	6.4	4.6

	May, 1919	April, 1919	March, 1919	Feb'y, 1919
Cost of train service per 1,000 gross ton miles	103.9	112.7	119.5	126.5
Locomotive repairs / Enginehouse expenses	35.4	38.6	40.8	43.1
Locomotive fuel	30.6	34.3	37.5	40.3
Other locomotive supplies	2.6	2.9	3.1	3.4
Enginemen and trainmen	31.1	32.4	33.5	34.8
Train supplies and expenses	4.2	4.4	4.6	4.8

MAINTENANCE INSRRUCTIONS FOR LAST SIX MONTHS OF 1919

New instructions outlining a working basis for maintenance of way expenditures for the last six months of 1919 have been issued to the regional directors by W. T. Tyler, director of the Division of Operation. While the new instructions are tentative and temporary, in order to control maintenance of way expenditures month by month during the remainder of 1919 to the end that the contract obligations of the Railroad Administration to the railroad companies may be fully complied with but not exceeded, they provide a definite basis on which maintenance officers may proceed as well as prescribing the character of the information which is to be used as the final standard.

While the Railroad Administration takes the position that an excess of expenditures for maintenance of equipment on any road may fairly be considered together with, and as an offset against, any deficiency that may result in maintenance of way expenditures on that road, it is stated that it is not the purpose deliberately to curtail maintenance of way in any respect with this in view and the new instructions treat maintenance of way expenditures on their own footing. Director General Hines has stated that, taking roadway and structures and equipment together, the average condition of the property as a whole is as well off as it was on January 1, 1918. This is because on some roads the equipment had got into a very run down condition at the end of 1917, as the result of the great pressure that had been put upon railroad facilities, and it was therefore necessary to make very heavy expenditures in 1918 in order to put it in condition for handling the war traffic, at a time when no one then knew how long it would last. Since the armistice traffic has fallen off and there was a mild winter, with the result that a large amount of equipment put in readiness for the winter is now being stored. A reserve of over 4,000 locomotives has been put in storage and every effort has been made to put the cars in good condition to handle the grain crops. Instructions were recently issued that car repair forces be put on full time at all points where a reduction in hours has been made and special attention is to be given to grain, coal and refrigerator cars in the sections where such cars are most needed.

In connection with figures showing the number of unserviceable locomotives and cars, Railroad Administration officials point to the fact that many locomotives are now reported as unserviceable, which merely require a few hours' work and could be used if necessary and would formerly not have been classified as unserviceable; also that cars which are in storage or are transferred from one region to another to be put in storage for the grain traffic may automatically be transferred to the bad order class because while good for most commodities they require some recoopering to fit them for grain.

The maintenance of way and maintenance of equipment programs are not being treated alike because they represent somewhat different situations. The equipment is being prepared for a possible car shortage this fall, but instructions have also been issued to the regional directors to concentrate repairs on locomotives and cars which by reason of their size can render the most efficient and economical service, to discontinue expenditures on small locomotives and cars not necessary for current use, and for the prospective traffic for the balance of the year, and to confine expenditures on small capacity freight cars to those authorized by Circular No. 20.

ORDERS OF REGIONAL DIRECTORS

Locomotive Maintenance Material.—Northwestern Regional Purchasing Committee Circular 68 states that many locomotives heretofore used on roads other than those to which they belong are now being returned to the owning road and that these locomotives were provided a supply of material for their maintenance peculiar to the individual engine by the using road. It is directed that this material be utilized in lieu of the purchase or manufacture of new material wherever possible.

Traveling Engineers' Association.—The Northwestern regional director, file 77-I-100; suggests that where it is deemed advisable, traveling engineers attend the convention of the Traveling Engineers' Association at Chicago commencing Thursday, September 9. Transportation should be furnished to the men attending and reasonable expenses allowed.

Freight Cars Damaged.—Supplement 1 to Circular 39 of the Southwestern regional director states that 12,183 cars were damaged in yards and trains on Federal controlled railroads during the week ending May 24, 1919, the cost of repairs for which is estimated at $310,764. While this is a substantial reduction compared with one year ago, and is also below the average for the entire year, still further improvements should be made, by closer supervision.

Leaky Western Pacific Cars.—Order 219 of the Southwestern regional director calls attention to claims for loss of grain by leakage from new Western Pacific cars, series 16,801 to 18,300. These cars should be repaired by seeing that there are no short floor boards, that the floors are well fitted around the posts and braces, and that the beveled grain strips are well fitted between the posts and braces and securely fastened to the floor. The side sheathing boards should be well secured by nails to the side-sill nailing timber.

Floor Racks for Refrigerator Cars.—The Northwestern regional director, file 16-1-65, states that Division of Operation, Circular CS43, has been withdrawn insofar as it applies to floor racks for refrigerator cars, and that authority should be received from the Division of Capital Expenditures before ordering material or beginning the application of floor racks in refrigerator cars which are not now equipped with them.

Application of Floor Racks to Refrigerator Cars.—Circular 225 of the Southwestern regional director states that the Division of Capital Expenditures will approve forms for the application of standard floor racks to refrigerator cars not now equipped with such floor racks and which are used for the transportation of perishable freight requiring floor racks for their proper refrigeration, provided such forms are approved by the corporation, with a commitment that it will take care of the finances. This is not to be construed, however, to require application of standard floor racks to cars now equipped with floor racks, except as renewals are required.

Charges for Application of Grip Nut Locks.—Circular 226 of the Southwestern regional director quotes a letter from Frank McManamy, assistant director, of the Division of Operation, relative to an interpretation made by Section 3, Mechanical, of the American Railroad Association that grip unit nuts, which take the place of a commercial nut and a nut lock, but which, under the rule as at present interpreted must be billed either as a common nut at $.035 per lb. or as a nut lock at $.03, are patented manufactured articles and may be charged as such at the net store department cost in accordance with Rule 105.

Repair of Box and Refrigerator Cars.—Supplement 15 to Circular 70 of the Northwestern regional director contains instructions for the repairing of box and refrigerator cars. Car repairing forces are to be at once put on a 48-hour basis at all points where reduction has been made below that figure. Repairers who have been furloughed are to be returned to service and, where necessary, forces will be increased. After the completion of the cars now in the shops, the rebuilding of box cars of 60,000 lb. capacity or less will be discontinued until the bad order cars on hand have been repaired. The Southwestern regional director has issued similar instructions in Order 215.

Safety Appliances on 80,000 Freight Cars.—The regional director, eastern region, by circular 500-92, promulgates a letter from Frank McManamy, assistant director of operation, calling attention to the importance of having all freight cars equipped with United States standard safety appliances by September 1. About 80,000 freight cars now in service need the equipment. These safety appliances are all of standard dimensions, therefore all cars, both home and foreign, should be equipped; there is no loss either of time or material in equipping foreign cars. These appliances constitute a betterment in the interest of safety which can properly be billed against the owners of the cars. Federal managers are called upon to report what progress they are making.

(Orders similar to the above have been issued by other regional directors.)

Pitch and Creosote as Fuel.—The performance of a heating furnace utilizing a fuel composed of pitch and creosote is reported in the engineering supplement of the *London Times.* Two tons of steel billets were heated in 55 to 60 minutes to 2,000 deg. F., using about 16 gallons of the fuel per hour. The internal size of the furnace is 10 ft. by 5 ft. by 3.5 ft. Equal weights of creosote and pitch form the mixture, which is kept at a temperature of 180 deg. F., and, strained through a wire gauze strainer of 40 meshes to the inch, is pumped through an injector type of burner.

CAR DEPARTMENT

THE OPERATION OF THE STANDARD "D" COUPLER

After a number of years of the most painstaking work on the part of the Coupler Committee of the Master Car Builders' Association, with the co-operation of the coupler manufacturers, a coupler design has been evolved which was questions as to its operation and construction are of growing concern to car department employees. The following description of the operation of the Standard Coupler is taken from an illustrated booklet published jointly by the several coupler manufacturers.

The coupler is shown in Figs. 1 to 5, arranged for top operation, and in Figs. 6 to 8 arranged for botton operation.

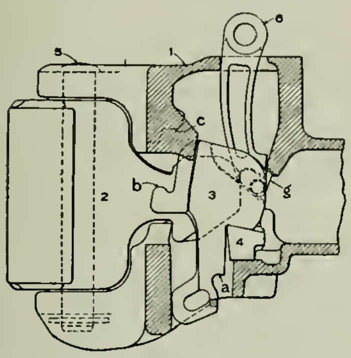


Fig. 1

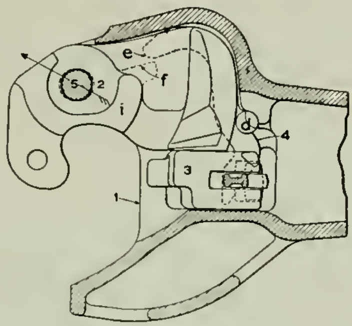


Fig. 2

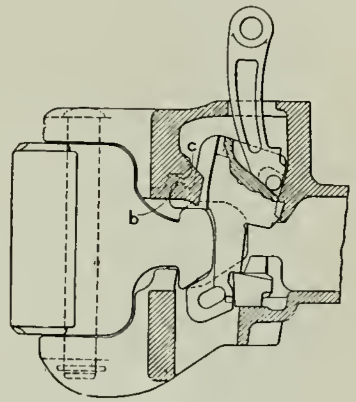


Fig. 3

adopted as standard by letter ballot of the association in July, 1916.

The coupler, known as the Standard "D" coupler, weighs about 400 lb., an increase of about one-third over the types previously in general use. The distribution of this metal, The essential parts of the coupler are the body 1, knuckle 2, lock 3, knuckle thrower 4, and knuckle pin 5, each of which, except the body, remains unchanged for either type of operation. When equipped for top operation the lifter 6 is used and when the coupler is intended for bottom operation the

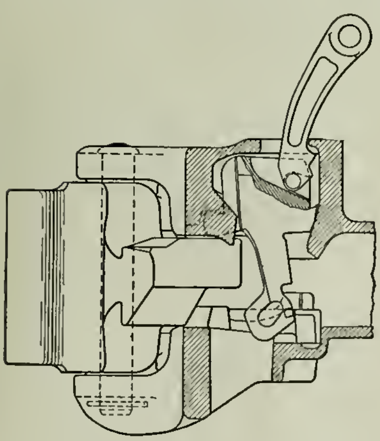


Fig. 4

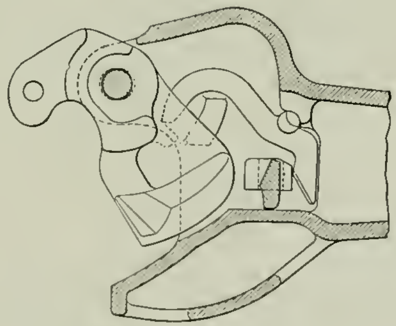


Fig. 5

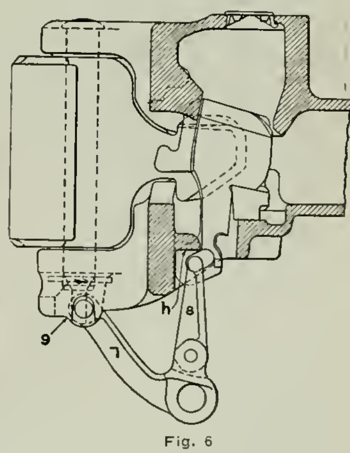


Fig. 6

however, has been such that tests indicate an increase of about 100 per cent in the ultimate strength and an estimated service life three times as long as that of the preceding types. This coupler is now rapidly coming into general use and bottom lock lifter 7 and toggle 8 are used, a cap covering the hole for the lifter 6 and lugs 9 providing a bearing for the lifter 7.

When in locked position (Fig. 1) the lock rests upon the top of one end of the knuckle thrower 4, and its head is located between the knuckle tail and inner guard arm wall as shown in Fig. 2. To lockset the lock, it is lifted either by the top lifter 6, or by the toggle 8, until the lockset seat *a* on the leg of the lock becomes level with the top surface of the knuckle thrower, whereupon the leg of the lock tips rearwardly and seats upon the knuckle thrower as is shown in Fig. 3.

In either top or bottom operating forms the lock is lifted at a point to the rear of its center of gravity so that there is always a tendency for the leg of the lock to swing rearwardly as soon as the lock is lifted. To throw the knuckle the lock is lifted above its lockset position until the fulcrum *b* upon its forward side strikes the shoulder *c* within the coupler head. The vertical movement of the lock is stopped by this contact, and the lock is thereafter forced to rotate about its fulcrum, which gives the lock leg a positive rearward movement, which in turn rotates the knuckle thrower about its trunnions *d*. The tip *e* of the thrower contacts the shoulder *f* on the underside of the knuckle and throws the knuckle open.

The lock-to-the-lock or anti-creep function is obtained in the top operated form by the co-operation of the lock lifter with the rear wall of the coupler head as shown in Fig. 1. When the parts are locked the lifter slides rearwardly in the lock until its projection *g* underlies the lower edge of the rear wall of the coupler head. Any upward movement of the lock merely binds this projection between the lock and the rear wall. As soon as the lifter itself is raised, however, it slides forward and upward in the lock and frees its anti-creep engagement. In the bottom operated arrangement the upper end of the toggle 8 (Fig. 6) normally underlies the projection *h* upon the lower wall of the coupler cavity, and thus performs the lock-to-the-lock function. When the lifter 7 and toggle 8 are raised to lift the lock the end of the toggle 8 slides rearwardly and up in the inclined slot of the lock leg and frees the anti-creep engagement.

In order to obtain the strongest possible anchorage for the knuckle within the coupler head and at the same time to allow the knuckle to swing freely when unlocked, the knuckle is provided upon its tail with the pulling lugs *m* and *n*, Fig. 9, which engage the corresponding lugs *o* and *p* upon the upper and lower walls of the coupler head, and serve to relieve the knuckle pivot pin of the greater part of the pulling stress. Above and below the lugs *o* and *p* are the buffing shoulders *q* and *r* against which corresponding shoulders on the knuckle bear in buff.

The forward pull upon the knuckle in draft not only pulls the knuckle directly forward against the pulling lugs, but also tends to force the knuckle laterally in the direction of the arrow in Fig. 2. To resist this lateral pressure the knuckle is provided upon top and bottom with the outwardly extending "pin protector lugs" *i* which enter correspondingly shaped recesses in the upper and lower walls of the coupler head. In order to relieve the knuckle pin of the greater part of pulling and buffing stresses the knuckle pinholes in the pivot lugs of the coupler are elongated slightly, as shown in Figs. 2 and 5, allowing the knuckle to take a firm bearing within the head in pull or buff without stressing the knuckle pin.

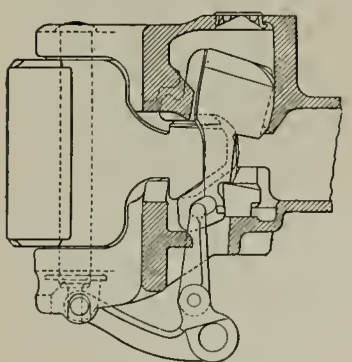


Fig. 7

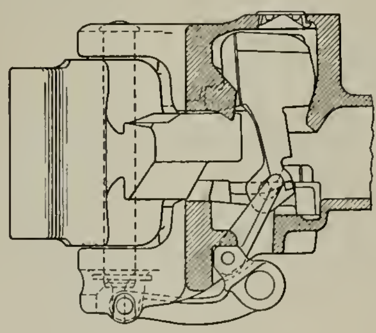


Fig. 8

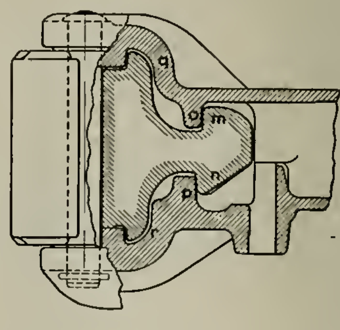


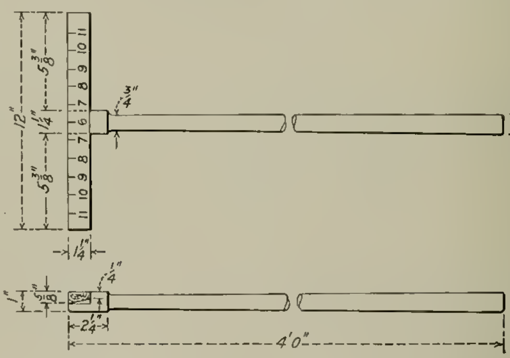
Fig. 9

THE MEASUREMENT OF PISTON TRAVEL IN YARDS

BY T. BIRCH

Air Brake Foreman, C. M. & St. P.

When making the incoming brake test it is necessary for the inspector to go over the train quite rapidly to inspect all the cars before the brakes leak off. Most men are unable to judge the distance the piston travels without going under the car, and for that reason rarely mark a car for brake adjustment unless it has very long travel. In order to overcome this trouble, car inspectors on the Chicago, Milwaukee & St. Paul have been furnished with a device for measuring the travel, which is shown in the drawing herewith. It consists of a scale 12 in. long mounted on a handle 4 ft. long. Both parts are made of seasoned pine material.



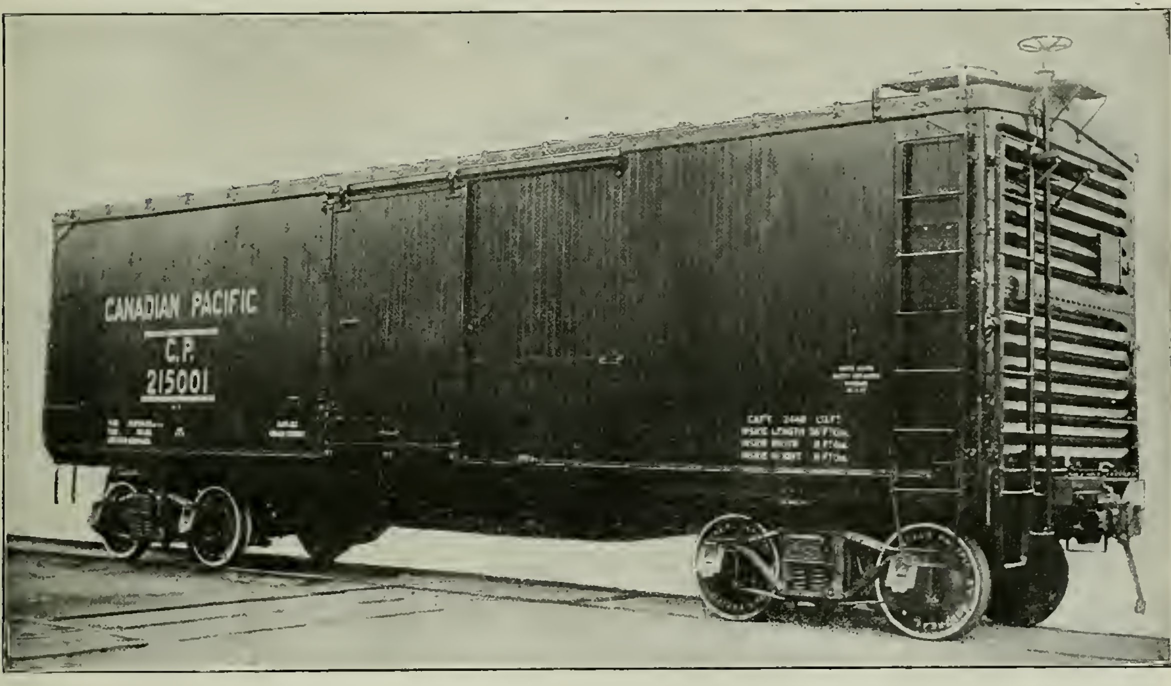
A Convenient Scale for Measuring Brake Cylinder Piston Travel

The scale is painted black and stenciled with white figures once inch apart, the numbers running from the center both ways. By holding the scale against the piston rod the travel can be checked accurately and rapidly without getting under the car.

C. P. R. Double Sheathed Box Cars

Length is 36 ft.; Weight 39,500 lbs.; Have Steel Underframe, Wood Superstructure and Metal Roof

The Canadian Pacific has built an order of box cars of the steel underframe, double sheathed type, the design of which in a general way is similar to the 40-ton double sheathed box cars designed by the United States Railroad Administration. The Railroad Administration cars, however, have an inside length of 40 ft. 6 in. and a height of 9 ft., with an actual weight of about 46,000 lb. Owing to the very high average box car load in 36 ft. by 8 ft. cars on the Canadian Pacific, the building of cars of these dimensions on trucks with 5-in. by 9-in. journals, with the additional weight which would thus be required, did not seem to be justified. The Canadian Pacific cars, therefore, have an inside length of 36 ft. and a height of 8 ft., the width in both cases being 8 ft. 6 in. An average tare weight of 39,500 lb. has thus been obtained, which represents a saving of over three ton-miles for each car-mile in the movement of loaded or empty equipment, as compared with the Railroad Administration standard car of similar type. The cars have been designed for a limit load capacity of 92,000 lb.



Double Sheathed, Steel Underframe Box Car Built by the Canadian Pacific

UNDERFRAME

Like the Railroad Administration cars the Canadian Pacific box cars have steel underframes built up on center sills of the fishbelly type. The center sills are built up of plates and angles, the web plates having a thickness of 1/4 in., with a maximum width at the center of 25 in. Each plate is flanged at the bottom with two 3 1/2-in. by 3 1/2-in. by 5/16-in. angles and at the top with a single 3 1/2-in. by 3 1/2-in. by 3/8-in. angle riveted on the outside of the plate. The top of the sills is completed with a 3/8-in. cover plate 26 1/2 in. wide, which extends continuously from end to end of the car. Bottom cover plates are also applied at each end, extending from the rear draft gear stop through the bolster construction to a point about halfway down the slope of the deepening section of the sills. These bottom cover plates are replaced for the remainder of the length of the car by the inside flange angles, the ends of which overlap the ends of the plates far enough to provide against weakening the section at the point of transfer.

The side sills are 6-in. by 4-in. by 3/8-in. angles with the horizontal flange at the top and extending outward. The end members of the underframe are 5-in. by 3-in. by 5/16-in. angles with the long flange placed horizontally, resting on the center sill cover plate and on the top flanges of the side sills.

The bolster is of the double diaphragm type. The pressed steel diaphragms are of 1/4-in. material spaced 9 1/2 in. apart, tapering with a slope of 2 1/16 in 12 from a maximum depth at the center of 13 1/2 in. A continuous top cover plate 15 in. wide is riveted at the ends to the side sills and at the center through the center sill cover plate to the top flanges of the sills. Filler diaphragms of 1/4-in. material are placed between the center sills and to these is riveted the center plate support casting. A bottom cover plate extends across the under side of the center sills, terminating just beyond the side bearings. The ends of the bolster diaphragms are secured to the vertical flange of the side sills by means of a filler casting to which all three members are riveted. Intermediate crossties of single diaphragm section are located at points 4 ft. 3 in. from the transverse center line of the car. The diaphragms of these members are of 1/4-in. plate with a depth at the center of 13 1/2 in., which decreases towards the sides of the car with a slope of 2 1/16 in 12. The flanges of these diaphragms are reinforced with a ½-in. top cover plate 7¾ in. wide, extending across the car above the center sill cover plate, and a short, tapering ½-in. bottom cover plate.

The intermediate floor beams are 4-in. Z-bars, attached at the center and side sills with angle connections and carrying the intermediate longitudinal floor support of 3-in., 6.7-lb. Z-bars, the web of which is placed 2 ft. 8⅛ in. from either side of the longitudinal center line of the car.

THE CAR BODY

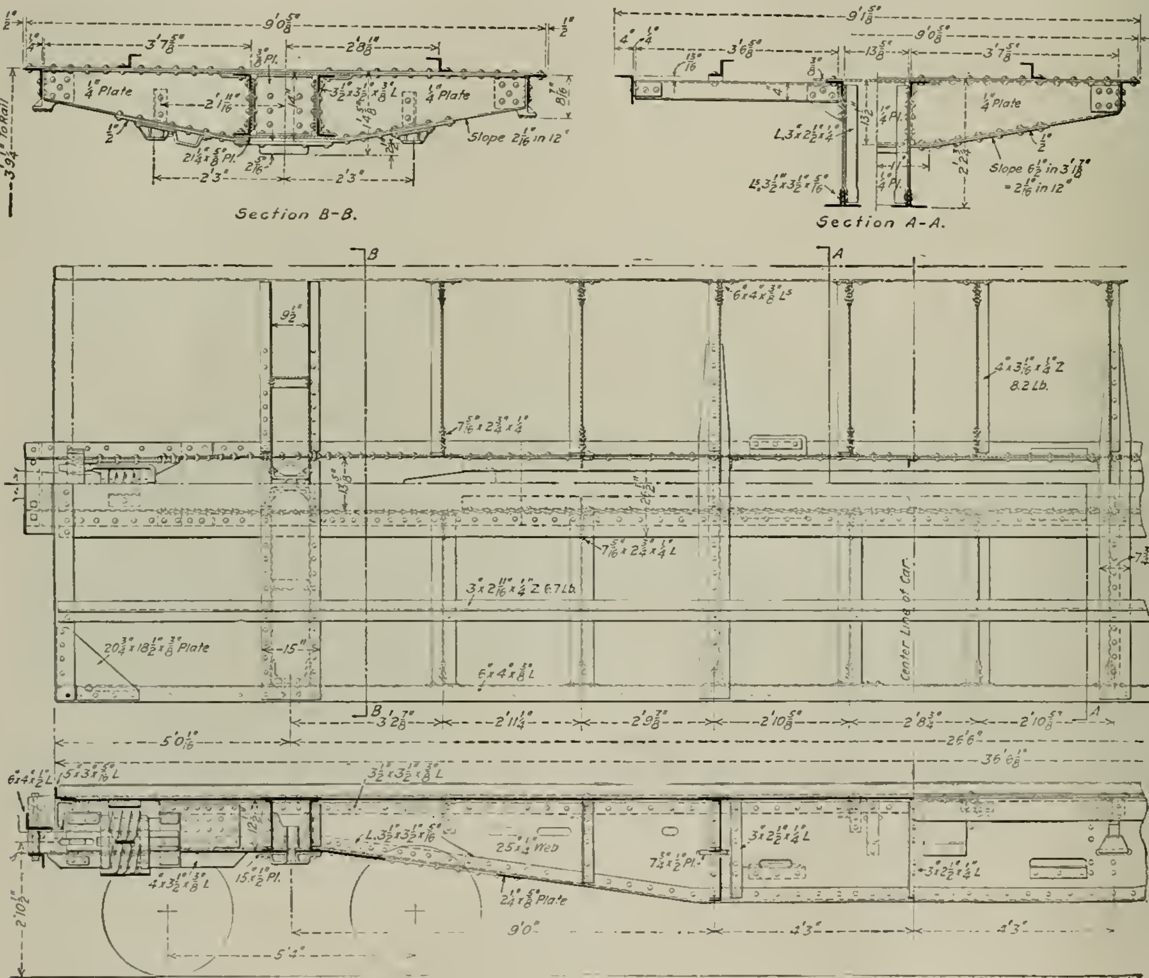
The design of the car body differs from the Railroad Administration cars in that the body frame members are not secured directly to the steel underframe. Above the side and end sills are placed 3⅝-in. wood stringers, to which the post and brace pockets are attached with bolts extending through the steel members. The floor is thus raised above the underframe structure, allowing the use of the intermediate Z-bar supports which have been previously referred to.

The side frame members are three inches thick, wood being used for the posts and braces with the exception of the intermediate posts. The wood posts and braces are of 3-in. by 4½-in. section.

The intermediate posts are 3-in. steel I-beams, these being used for the purpose of providing ample stiffening against bulging when the car is loaded high with grain. The C. P. R. cars also differ from the Railroad Administration cars in that diagonal brace rods are used at each channel section to provide against endwise racking of the car superstructure. The side plates are of 7-in. by 3½-in. section, while the end plate is formed integral with the corrugated steel end of the car.

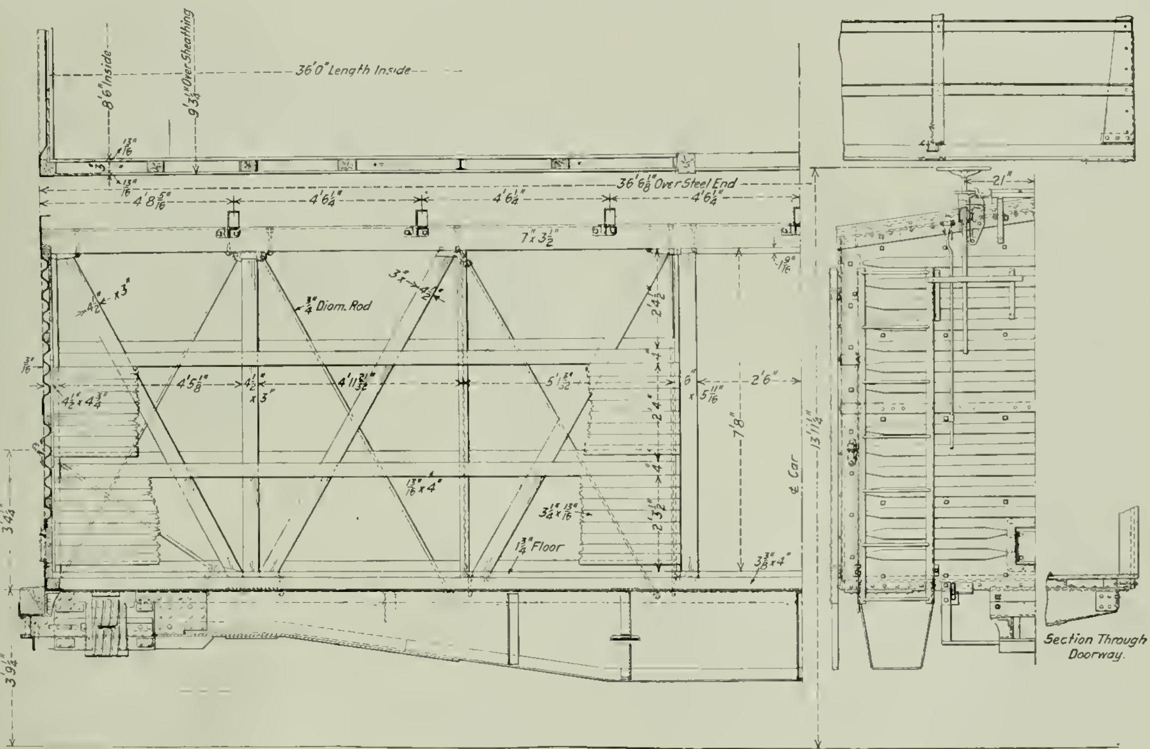
The outside sheathing is standard 13/16-in. tongued and grooved material nailed in the usual way, and in addition to nailing, it is further secured at the side sill by a steel angle bolted at frequent intervals. There are two girths on each side of the car and the inside lining is carried up to the second girth, 5 ft. 3½ in. above the floor. The ends are lined full height with tongued and grooved lumber 13/16 in. thick, which is placed vertically and nailed to strips secured in the bottoms of the steel end corrugations by means of bolts, the outer ends of which are riveted to the steel end sheet.

The side door openings are five feet wide. The doors are of wood, bound with metal on all of the edges. The band at the back edge of the door is arranged to engage with the strip on the back door post, forming an effective weather and spark strip and further securing the door from



The Underframe of the Canadian Pacific Box Cars bulging outward. The front stops are of wood, braced with malleable brackets. The locking arrangement is of the combined lock and stop type equipped with a door starting lever. Two handles are provided on each door, one on the bottom for track level operation and the other near the center girth for platform operation.

Two types of roof are applied to these cars, one an outside metal roof and the other an inside metal roof. The carlines for both roofs are of 4-in. angles, which are attached to the side plates by means of malleable brackets.



Sectional Views Showing the Body Construction and Half End Elevation

These brackets are secured to the plate by two horizontal bolts, with the nuts on the inside of the car and the head secured from turning by a flanged double washer plate located back of the facia board.

TRUCKS

The cars are fitted with trucks of the arch bar type with a wheel base of 5 ft. 4 in. and 5-in. by 9-in. journals. The bolsters are the Simplex type with long column guides to provide the maximum area between the bolster and the cast steel truck columns. The trucks are fitted with roller type side bearings.

Value of the Railroads.—According to a series of graphic illustrations showing the value represented by the railways of the United States, as compared with that of all manufacturing industries generally, compiled by E. B. Leigh, president of the Chicago Railway Equipment Company, the value of railway cars and locomotives is $4,137,318,000 and that of manufacturing machinery, tools and implements of all other trades $6,091,451,274. A comparison of the locomotives and cars with all farm implements and machinery indicates that the value of the railroad equipment is nearly three times that of the farming machinery and implements of the country.

SPECIFICATIONS FOR PLATES FOR FORGE-WELDING IN TANK CAR CONSTRUCTION*

The chairman of the Tank Car Committee of the Master Car Builders' Association, A. W. Gibbs, requested Committee A-1 of the American Society for Testing Materials to issue a specification for forge-welding plates suitable especially for tank cars. This matter was referred to Sub-Committee II and initial work taken up with particular reference to the M.C.B. specifications for the Class V tank car.†

In a note appended to the tank specifications it is stated that because of the character of the commodities to be shipped in these cars, it is so important that the tank shall be absolutely tight, that riveted tanks will not be permitted, and all seams shall be welded. The specifications are as follows:

1. *Bursting Pressure.*—The calculated bursting pressure, based on the lowest tensile strength of the plate, shall be not less than 960 lb. per sq. in.

2. *Material.*—(*a*) All plates for tank, and for dome if dome is made of plate, shall be of steel complying with the American Society for Testing Materials Specifications for Boiler Plate Steel, Flange Quality. For the purpose of welding, the lowest carbon content consistent with the strength prescribed for this quality is desired.

The requirements of the A.S.T.M. specifications for boiler steel, flange quality, are:

Chemical Composition

Carbon, per cent		....
Manganese, per cent		0.30-0.60
Phosphorus, per cent	Acid	not over 0.05
	Basic	not over 0.04
Sulphur, per cent		not over 0.05

No increase allowed for check analysis.

*Abstract of the report of Sub-committee II of Committee A-1, on steel, presented at the annual meeting of the American Society for Testing Materials, held at Atlantic City, June 24-27, 1919.

†See M. C. B. Proceedings, 1918, page 903, for the Class V tank car specifications. This car is intended for the transportation of liquid products, whose properties are such as to involve danger of loss of life in the event of any leakage or rupture of the tank.

PHYSICAL PROPERTIES

Tensile strength, lb. per sq. in.	55,000-65,000
Yield point, lb. per sq. in.	0.5 tens. str.
Elongation in 8 in., per cent	$\frac{1,500,000}{\text{Tensile strength}}$

Reduction in elongation allowed for increased thickness.

There apparently was some objection on the part of the fabricators to using steel of such high tensile strength for welding; hence a softer grade was proposed. The following specifications were recommended to be adopted as tentative:

CHEMICAL PROPERTIES

Carbon	not over 0.18 per cent
Manganese	0.30-0.60 per cent
Phosphurus	not over 0.04 per cent
Sulphur	not over 0.05 per cent

PHYSICAL PROPERTIES

Tensile strength, lb. per sq. in.	plates 3/4 in. or under in thickness	48,000
	plates over 3/4 in. in thickness	45,000
Yield point, lb. per sq. in.		0.5 tens. str.
Elongation in 8 in., per cent		$\frac{1,500,000}{\text{Tensile strength}}$

All parties at interest seem to be agreed that carbon becomes a deterrent to good welding when in excess of 0.18 per cent. To encourage the narrowing of the working limits at the mills, it was determined to fix the chemical limits as "check analysis limits," without the 25 per cent excess allowance in the Specifications for Structural Steel for Cars. The sulphur limit was then placed at 0.05 per cent, which is somewhat closer than 0.045 per cent with 25 per cent excess on check analysis allowed in the revisions presented last year. The consensus of opinion is that copper should be left out of the specifications. Limits for silicon, nickel and chromium have been set at 0.05 per cent for each element.

The sub-committee was advised by Mr. Gibbs that "the question of tensile strength is subordinate to that of the welding qualities, for if the chemistry required involves low tensile strength, the specified bursting strength can be obtained by increasing the thickness of the plate." The opinion seems to be unanimous that a soft steel is necessary, the general aim being for a carbon content of from 0.08 to 0.12 per cent for satisfactory welding properties. Having fixed the maximum carbon at 0.18 per cent, and bearing in mind the lower values which are worked to, it was seen that the tensile strength of thick plates would surely drop below 48,000 lb. per sq. in., but that the lowest carbons in the thinner plates would probably not run the tensile strength below 48,000 lb. Therefore, in order to permit designers of welded tanks when plates 3/4 in. or under in thickness are used, to have the benefit of this figure, the tensile strengths have been specified at 48,000 lb. for plates 3/4 in. or under and 45,000 lb. for plates over 3/4 in. in thickness.

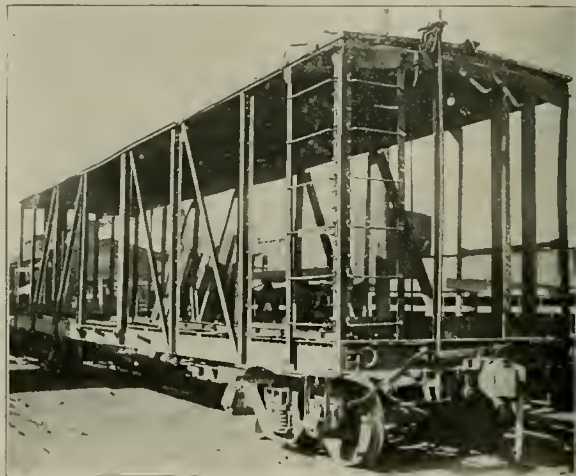
Requirements for elongation, including modifications for thick and thin plates have been made substantially the same as for structural steel for cars. Bend test requirements, however, are somewhat more severe, the bend specimen being required to bend flat on itself through 180 deg. irrespective of the thickness of the plate.

It is believed that the specifications will meet with general approval. Two of the leading consumers of this material, who are manufacturers of tanks for cars by the forge-welding process, are members of the sub-committee and voted favorably. Two manufacturers who are not members of the society were consulted and expressed themselves as favorable.

TECHNICAL MEN UNIONIZING.—Extensive unionization of engineers is predicted in the Chicago Daily News by A. J. Oliver, president of the International Federation of Technical Engineers, Architects and Draftsmen. He says the membership now amounts to 5,000 and before the end of a second year they expect to have three times that number. The organization is affiliated with the American Federation of Labor.

DURABILITY OF STEEL ENDS AND STEEL ROOFS

The ultimate economy of substantial construction of freight cars is shown in a striking manner by some interesting reclamation work which the Illinois Central recently performed. Several months ago a box car belonging to a foreign line was almost entirely destroyed in an accident. The steel



Steel Roofed Car After Passing Through Fire

ends were the only part of the car that could be salvaged and, although so badly bent, were sent to the Burnside shops where they were received in a condition shown in the first illustration. These ends were straightened under a press at a total cost of $13.06 and were later applied to an Illinois Central box car. The condition of the ends after straightening was such as to make them practically as serviceable as when new.

Steel Ends Removed from Destroyed Box Car

A similar instance in which a badly damaged steel roof was reclaimed is shown in the second photograph which gives a view of the framework of a 40-ft. box car that passed through a fire which completely destroyed the woodwork. This car was equipped with a heavy gage, all steel roof, which as will be noted, sagged badly at the center and also between the side posts. The roof was removed and after being straightened was found to be in such good condition that it was reapplied without the addition of any new material.

What is Modern Malleable Iron?*

A Brief Sketch of Present Day Methods of Manufacture and Characteristics of the Material

BY H. A. SCHWARTZ
Chief Metallurgist, National Malleable Castings Company, Indianapolis, Ind.

During the last twenty years there has been a fairly continuous tendency to substitute for malleable cast iron car parts details made of steel. In view of the fact that the organization with which the writer is connected manufactures both malleable cast iron and steel, this change of policy on the part of car builders is of relatively little commercial importance to the company. Nevertheless, it is a source of gratification to have an opportunity of presenting to a railway organization some pertinent facts concerning the manufacture and properties of malleable cast iron for the information of its members when dealing with promlems of new construction and repair.

Neither steel nor malleable cast iron is best for all purposes. There are many cases throughout all industries where steel is used ill-advisedly in preference to malleable cast iron, and some in which the reverse is true.

All malleable iron made in the United States is produced along the same general lines of manufacture, though there are very considerable differences of quality between the products of various firms according to the degree of skill which each producer possesses in the execution of generally similar operations. It is for the purpose of wiping out as far as may be possible such dissimilarities of quality that the American Malleable Association was formed some three years ago. This organization, maintaining as it does a research committee and a consulting engineer, has been of extreme value to the consuming interests in standardizing and improving the product of its members. At present the association maintains what is practically equivalent to an inspection bureau, which assures the consumer that the product purchased from those of its members in good standing will be of a uniformly good quality, at least equal to the requirements of the American Society for Testing Materials, which requirements are also standard with the United States Railroad Administration and similar organizations.

Up to about 1900 the progress in the production of malleable iron was not well systematized, but there had been evolved methods of procedure which, when carefully followed, yielded results generally satisfactory to the consumers of the period. Prior to this time there had been educated a rather limited number of very highly skilled foremen, who, by extremely close application and extraordinary force of memory, were able to interpret very well what they saw going on in the foundries and annealing departments, and to maintain, one might also say by inspiration, a sufficiently accurate control over manufacturing conditions to cope with the requirements of the time.

At approximately this time there developed a much greater general interest among engineers in metallurgical problems, considerable advance was made in the theoretical side of metallurgy and a number of producers began to attempt the introduction of better methods in their process of manufacture. The writer has been informed that as early as 1893 certain producers of malleable cast iron attempted the operation of a laboratory. Report seems to differ as to just how successful the operation of these early laboratories was and what bearing they had on control of the product which they were supposed to supervise. At any rate, in 1903 the National Company built at its Indianapolis Works a chemical laboratory for the study and control of its product. When beginning this work we found the knowledge of the subject in a rather chaotic condition. Little by little, however, order grew out of confusion, some of the company's other plants began similar work, and the problems of the industry attracted the attention of university men and others doing research work, until at present at least the broad fundamentals of the industry are firmly established, and the reason for all the operations undertaken and the circumstances under which these operations may be expected to be successful, are clearly understood.

Process of Manufacture

It may not be without interest to know just what steps are taken in well operated plants to maintain the product up to the desired standard, and to safeguard the consumers' interest against inferior material. The pig iron, which is the raw material of the malleable manufacturer, is all bought under chemical specifications and it is required that all deliveries be accompanied by analyses made by the blast furnace chemists to determine the composition of each individual carload or other unit. These analyses are checked on each carload of iron in the consumer's laboratory, and the metal is finally used on the basis of our own analyses rather than the seller's. If, however, by any chance the foundry's analysis differs from the blast furnace's by more than what is believed to be the manipulative error of analytical methods employed, it is customary to take from the carload of pig iron a second sample and to reanalyze this sample for comparison with the first. In this way it is possible to guard very thoroughly against unknown variations in the composition of metal used as our raw material.

Malleable iron is in general made in heats varying in size between 6 and 30 tons in different plants. The usual size is, perhaps, 10 or 12 tons. The chemical composition of the iron as cast is of extreme importance as fixing the quality of the product. Accordingly the combination of pig iron, scrap, etc., entering the furnace is carefully computed to give an average composition such that after the unavoidable change in chemical composition occurring in melting has taken place, the product will be of the quality desired.

As a check upon the melters, each heat is analyzed before the next heat made under the same conditions is put into the furnace, and from such information the melter is enabled to make any necessary changes in the charges entering his furnaces. In some special cases, notably in the electric furnace operation developed by our company, the heat

*From a paper read before the Car Foremen's Association of Chicago.

is analyzed before it is poured into molds, and an adjustment of chemical composition made when necessary to bring it in line with the desired practice.

The product of the foundry in a malleable plant is not, as is frequently supposed, gray iron. Gray iron is not annealable in any commercial sense, and when an attempt is made to apply this heat treatment to gray iron, a totally valueless commercial product results. The castings as they come from the mold in a malleable foundry are entirely white in fracture, are exceedingly brittle, and also extremely hard—so hard that they can not be worked with any other cutting tools than abrasive wheels. These castings are then packed in containers, sometimes surrounded by chemically active packing materials, and sometimes not, and heat treated over an extended period. In general commercial practice this entire heat treatment occupies about one week.

Within recent years most well conducted malleable foundries have adopted the practice of supervising this heat treatment by means of various types of pyrometers. The most successful of these are the recorder type which maintain a continuous record day and night of the changes of temperature. In this way those in charge of the anneal are enabled to check up the work of the night foreman, and the plant executives are enabled to check the methods of the men responsible for the operation of the annealing departments.

Furthermore, there are cast from each heat a number of test bars of the form and dimensions prescribed by the American Society for Testing Materials, and these bars are annealed with the castings. They are then broken as provided by the A. S. T. M. specifications to insure the fact that all the operations have indeed been so conducted as to produce the desired physical properties.

PROPERTIES OF MALLEABLE IRON

The American Malleable Association maintains a testing department under the supervision of Mr. Enrique Touceda, of Albany, N. Y. This laboratory tests every day bars from the plants of the firms which are members of the association. The writer has not taken the trouble to average these results recently, but from general inspection it is quite obvious that the tensile strength of malleable iron as made today approximates 50,000 lb. per sq. in., and the elongation is about 10 to 12 per cent as compared with the A. S. T. M. specifications of 45,000 lb. per sq. in., combined with an elongation of 7½ per cent.

The tensile properties of a material are the most easily determined engineering constants, and are, therefore, generally used as a measure of the quality of a product. In general, however, relatively few structural details are subjected to purely tensile stresses. Rather more common loadings are those causing cross bending, that is, where the structural detail acts as a beam loaded either at the end or at the center, or bearing a distributed load over a greater or less portion of its entire length. It has been determined that the modulus of rupture of malleable iron in loadings of this character is approximately 100,000 lb. per sq. in., and that the deflections before breaking are very great, so great indeed as to prohibitively distort the member before it actually ceases to carry any load. The material can be loaded to approximately half this intensity without passing its elastic limit.

In pure compression malleable iron possesses properties rather closely akin to those of soft steel, since both these materials in the form of short, thick details will carry almost any amount of load in comparison without breaking, though both of them will be much shortened and flattened under the influence of loads of this character. In the form of washers and similar details there is no doubt that the ultimate strength approaches 100,000 lb. per sq. in. Columns and struts made of any material, while, of course, they are primarily intended to bear compression loads, are always considerably weaker than the compression strength of the material would indicate, inasmuch as they fail, not by crushing, but by springing out of line and then bending. Their behavior under loads depends primarily upon the ratio and length to diameter of the column, and malleable iron, of course, is not usually used for columns of any considerable length.

Tests of details supposed to be representative of rather unfavorable design have shown an untimate strength of 25,000 or 30,000 lb. per sq. in. in loadings of this character. In shear, for example, when used as pins, malleable iron has a strength approximately equal to its tensile strength, or perhaps slightly less.

COMPARISON OF MALLEABLE IRON, CAST IRON AND STEEL

By way of a brief summary, it may not be uninteresting to sum up in the form of general statements a comparison of malleable iron with its two competitors, gray iron and cast steel. The tensile strength of malleable iron is approximately three-quarters that of soft steel, its elongation is a little less than that of steel, while in comparison with cast iron, the tensile strength is, perhaps, twice as great as the best cast iron, and the latter material has no permanent elongation in any measurable degree.

In cross bending, gray iron is slightly stronger than either malleable or steel, and steel is slightly stronger than malleable. Malleable iron and steel deflect to the same degree under loads of this character, and both of them distort so much before failure that there is no particular choice between the two materials from this point of view. Gray iron has no deflection under loads of this kind and is inclined occasionally to break without warning.

In compression malleable iron flows out perhaps a little less rapidly than steel, and not quite to the same degree. Gray iron deflects less rapidly than either of the other products, but crushes into fragments at loads which have not deformed malleable or steel to any material extent. Gray iron is valueless under shearing loads, whereas malleable iron has about the same properties as wrought iron, and nearly the same properties as soft steel under loads of this character.

Within the elastic limit the behavior of soft steel and malleable iron, when subjected to twisting, is very much the same. Steel, however, will take a greater twist than malleable iron without completely tearing off, though up to the point where the member is distorted permanently there is no choice between the two materials. Gray iron is too brittle to stand stresses of this character.

Gray iron serves its most useful purpose in the form of columns, where its stiffness prevents the distortion which finally leads to failure by bending. In such cases as, for instance, the queen posts of car construction, this is not as great an advantage as it seems, for the detail may be broken by an accidental blow and, therefore, be rendered inoperative for the stress which is normally applied to it.

Malleable iron will bend sufficiently to permit of its being fitted against adjoining structural details just as readily as steel. When subjected to such tests as bending double, cold, it is not as malleable as soft steel. Such tests, however, are of course not incurred in actual commercial use. It resists shock better and more continuously than either one of its competitors. The most convincing evidence of this fact to a railroad man should probably be its extended use in draft gears, in which the duty of this character is extremely severe. Its microscopic structure is such as to prevent the formation and growth of cracks which cause the failure of a good many structural details of steel under repeated stresses, particularly if these stresses are in different directions.

Malleable iron resists rusting and corrosion to a greater extent than steel; it equals, and sometimes surpasses, cast iron in this respect, more particularly if the cast iron has been carefully cleaned of sand burned to the surface. In the nature of the case, malleable cast iron is entirely free from any internal strains, due to manufacturing operations, since the long continued anneal to which it has been subjected has of necessity relieved any strains of this character. It furthermore has an advantage in structural details, in that it can be cast of lighter sections than steel, and consequently there are a great many illustrations of railway equipment in which the steel casting is much heavier than would be required to sustain the load because of the relatively greater sluggishness of the metal of which it is poured. The gray iron has to be heavy in order to resist the service strains.

Very usually there exists in the minds of consumers of malleable iron an idea that the strength of malleable iron is all in the skin; that the anneal penetrates only a limited amount, or that malleable is useless in heavy sections—the thought in each case being that there is a limit to the thickness in which malleable iron can be manufactured. Whatever form this idea takes, the conclusion is entirely erroneous. The extreme surface of a test bar of malleable iron is somewhat stronger than the exact center. It is not, however, very materially stronger, possibly 10 per cent, and it is quite possible to make malleable castings several inches thick in which the central portion possesses all the physical properties required by official specifications.

The annealing of malleable iron is not primarily a process involving the removal of carbon from the surface. Such a removal does unavoidably occur, and occurs also in the annealing of cast steel. The actual change brought about by annealing is the destruction of the combined carbon in the original white iron casting by converting it into a special form of free carbon known as temper carbon. This reaction does not start at any one place in a mass of metal any sooner than in some other place, but goes on uniformly throughout the section. Indeed under most commercial conditions combined carbon persists in the surface a little longer than it does at the center.

A much more important point in the design of malleable castings than a question of producing sections which are fairly thin, is to so design the casting as to permit the foundry an opportunity of eliminating shrinks, cracks, etc. Malleable iron is less subject to this difficulty than steel, but considerably more subjected to it than gray cast iron. There are an indefinite number of instances in which draftsmen and designers have decided upon shapes and sections not particularly essential to the use of the detail being designed, which present almost insurmountable difficulties in the foundry. Illustrations of this character are, for instance, wheels having light rims, very heavy hubs and an even number of perfectly straight spokes. It is quite easy to produce a design of a wheel of this character in which the foundry problem ceases to be a commercial one and amounts to the working of a miracle on the part of the molding department to keep the spokes from cracking or from pulling loose from the hubs. Another difficulty frequently encountered is a part so designed as to have in general very heavy sections, and then at a remote and inaccessible point, an important detail of very small cross section. Without going deeply into the metallurgy of the process, it may be said that special efforts have to be made in cases of this kind to make it possible to run the small, thin portion at all satisfactorily, unless this small portion is located so that it can be brought close to the gate through which the metal is poured into the mold. These and similar items are in addition to the usual problems of the design of cast details such as producing a design which does not require the use of cores to produce unnecessary pockets, designs which can be made in a two part flask and other similar self-evident matters.

MODERN REFRIGERATOR EQUIPMENT*

BY L. L. YATES

General Superintendent Car Department, Pacific Fruit Express

The refrigerator car was primarily designed for the transportation of fresh meats for a comparatively short distance, little thought being given to the dimensions or general design. The success which was met with its advent for this purpose, was such as to warrant extending its use for the transportation of other perishable commodities and longer hauls. This necessarily developed the fact that refrigerator cars as originally designed would not meet all requirements.

In the latter part of the nineteenth century, because of the length of the hauls, which increased as more distant markets demanded perishable commodities, and to eliminate as far as possible losses from decay in transit, more thought was given to the design of refrigerator cars as to dimensions, insulation and capacity of ice bunkers. Since that time there has been very rapid development in the design and construction of these cars, which, when properly loaded and handled, will insure the delivery of perishables at distant markets in practically as good condition as when loaded into the car, this being the result of complete co-operation between shippers, the United States Department of Agriculture, rail lines and car lines, which enabled the carriers to determine the proper dimensions, quantity of insulation and type and size of ice bunkers to use.

CONSTRUCTION

The lumber must be well seasoned to prevent shrinkage when framed and assembled. The efficiency, quantity and application of the insulation is of the utmost importance, and has been given more thought than any other feature in the construction of the refrigerator car. It will readily be seen, on account of the belt rails, sills and carlines, that difficulty is encountered in maintaining the continuity of the insulation, which is highly desirable. Particular care is taken in the application of the insulation to the car, to see that it is not only securely applied, but all parts protected, and vertical dead air spaces frequently blocked to prevent circulation within the walls, which, if not prevented, would assist in the absorption or radiation of heat. The insulation in the floor of the car, which is highly important, is more susceptible to damage or deterioration due to the misuse of equipment, such as driving nails or spikes into the floor to brace the load, loading ice or commodities requiring ice in packages, and other commodities which later require the washing of floors, with the result that moisture will penetrate the insulation, affecting not only its efficiency as an insulator, but also the floor timbers, causing rapid decay or deterioration.

The floor insulation itself should be as nearly waterproof as practicable, without impairing its efficiency as an insulator, and when applied should be well coated with an odorless waterproofing compound, with a melting point of not less than 175 deg. F., which must be pliable at zero, highly adhesive when hot and not sticky when cold. This requirement is necessary to meet the extremes of temperatures, both hot and cold, to which these cars are subjected. This waterproofing compound should be liberally used around the side walls at the floor line to prevent capillary attraction in the side-wall insulation.

The side and end sills should be thoroughly coated after framing with red lead and oil, or some other preservative of equal merit. It is also necessary to minimize, if not entirely eliminate, the use of bolts through the insulation, as they afford direct channels for the heat transmission.

The main floor should be of select vertical grain lumber, with the edges laid in white lead and oil and coated with raw linseed oil. Other parts of the interior of the car should re-

*Abstract of a paper presented before the Pacific Railway Club.

ceive one coat of raw linseed oil and two coats of waterproof varnish. The floor, side and end lining around the ice bunkers should receive a coat of mineral paint carrying a high percentage of raw linseed oil to prevent decay from condensation.

There are approximately 140,000 refrigerator cars in the United States, the majority of which have been constructed in recent years, and are built in accordance with recognized designs, suitable for the business for which the cars are intended. There are, however, many older cars that are being made to conform to modern methods of construction.

MAINTENANCE

The Pacific Fruit Express Company owns and operates 15,600 refrigerator cars of the most modern type. To maintain them in a high state of efficiency, each car as it returns to California after a trip East, before being placed for loading, as a rule passes through one of our shops, whether or not it is in need of repairs, where it receives the most careful inspection by specially trained men. Any defects discovered are plainly marked with chalk and written up on an inspection card, which is placed on the car door. Following these inspectors, are repair men, who are trained and skilled in their respective crafts, carpenters making any repairs necessary to superstructures, truckmen on underframes, trucks and brake rigging, tinners making ice tank repairs, upholsterers, side-door and hatch-plug padding, air brake men testing all air brakes and cleaning and repairing all that may require such attention. Car cleaners thoroughly clean the ice bunkers and the body of the car, and if the car contains oil spots or other foreign matter requiring washing, this work is done by another class of workmen. The interior walls and ceiling, if in need of revarnishing, are attended to by painters.

After all this work has been performed, inspectors make an after-inspection to see that the repairs have been properly made and the car is in safe and serviceable condition, particular care being given to the side doors to see that they are perfectly tight. The side doors are then closed and sealed with a heavy wire, and the ventilators set in an open position, permitting thorough ventilation. The car is then ready for service and is marked under the side door with the date on which it is OK'd and reported on the yard report to the general or district agent for forwarding to the loading station.

This work is all performed in the light repair yard. Any cars requiring extensive repairs are switched to the heavy repair yard, or reconstruction shed, where men specially skilled in the art of rebuilding refrigerator cars are employed. Here any wood part or insulation showing decay is removed and replaced with new material, special care being given to the renewing of insulation in a workmanlike manner to see that the vulnerable parts are protected. This work is under the supervision of foremen who have had years of experience in refrigerator car maintenance, and are cognizant of the functions of the refrigerator car.

The location and volume of perishables shipped from Pacific coast points render it impossible at all times to pass cars through our main shops, and in this event, we have inspectors and repair men at the principal loading centers to thoroughly clean and make minor repairs, and cars requiring heavy or general repairs are forwarded to one of the main shops.

In view of the fact that over 100,000 carloads of perishables are hauled annually from Pacific coast points in Pacific Fruit Express equipment, it necessarily follows that each of its 15,600 cars receives inspection and repairs on an average of seven times per year.

Railroad companies realize the importance and necessity of the proper maintenance of refrigerator cars and when they find them in damaged or bad-order condition, requiring extensive repairs to superstructure, as a rule, endeavor to return them to the car owner for repairs, as the owner has the material and trained mechanics to repair them properly.

No doubt many little realize the work and the attention given to the cars that are handling perishables. Any of you who have not been to a well organized refrigerator repair shop would be surprised to see the inspection and attention given to refrigerator cars, minor repairs that you would not consider making on any other equipment. We are fully alive to the highly perishable commodities handled by this equipment and appreciate the necessity of keeping them in a safe, serviceable and sanitary condition. Go into a refrigerator car and inspect the construction and you will find that all parts that would collect any foreign matter and be injurious to the load have been eliminated.

The United States Department of Agriculture has been of very great assistance to the car designers in improving the equipment. Last year the Railroad Administration appointed a committee to design a standard car for the government. That committee was composed of four representatives of the car lines and two from the Department of Agriculture. The car designed for the government was not the car that any of us would want individually. It was the result of take and give on the part of each of us, but I am sure that none of the committee regrets the design finally proposed and accepted by the government. The Railroad Administration has the acme of perfection in the refrigerator car today.

Out of the 140,000 refrigerator cars in the country the majority are good for the purpose for which they are intended. All refrigerator cars are not intended to handle perishables from California. Many of them are for meats and dairy products and short haul runs. Cars that were considered efficient twelve or fifteen years ago are obsolete today for long hauls.

DISCUSSION

L. W. Collins (Refrigeration Technologist, U. S. Department of Agriculture).—For the past year I have been connected with the Pacific Fruit Express Company in carrying on a series of investigations for the committee appointed by the Railroad Administration, to outline and devise a certain method of heating cars to prevent so much damage in transit from cold weather. A plant has been constructed at Roseville where there was developed a type of heating system that was put in the P. F. E. cars last winter. We loaded trains to go through to New York, a fourteen-day trip, and on these trains we had the government system of heating and all the present types of cars on the market. There were six types of heaters. It was found that the fruit temperatures were increased very materially on the top part of the load and freezing at the bottom with the average difference in temperature of 30 degrees F. and in some of the systems there was only 12 degrees between the top and bottom of the load. In the government car during the high winds in Wisconsin there was a difference of 4 degrees. The car companies and car lines have not been able to get the shipments through except on the short lines. In the winter there has been no provision made other than the temporary method for heating the cars and in the years 1917 and 1918 there was an estimated loss in New York City of $1,000,000 worth of food products on account of being frozen in transit. With everyone working along the lines of development in getting the best type of heater, we all hope to be able to very materially reduce the tremendous losses in the winter time that the railroads and the car lines have suffered in the past.

On the car developed at Roseville we have insulated air space and put stringers one and three-quarters inches on top. These were formed to furnish hot and cold air ducts in the center of the car, where the door was so arranged as to carry the heated air from the top to the bottom of the bunker and the cold air was drawn down. There were three different types of heaters, using steam, alcohol and kerosene. Each one had some advantages and it is not yet definitely decided which type is more desirable.

SHOP PRACTICE

ELECTRIC ARC WELDING APPARATUS

BY H. L. UNLAND

Power and Mining Engineering Department, General Electric Company

There are several simple precautions to be observed in the use of electric arc welding equipment whatever the nature of the apparatus may be. Many of the accidents which occur are generally the result of a misconception of the nature of the equipment and its proper use. This applies more particularly to the auxiliary apparatus.

The eyes should be thoroughly protected by a mask from the light of the arc or serious burns to the interior of the eye will certainly result. No chinks or holes in the mask should be permitted since only a brief exposure of the eyes is required to bring on painful results. The inside of the mask should be kept painted dull black to prevent reflection of the light from behind.

The mask consists of a thin sheet of aluminum formed to the proper shape and provided with an adjustable band for supporting it from the operator's head. An opening in the front of the mask is provided for a window of glass, which may be either a number of individual sheets of different colors or a single compound sheet of glass.

The colored protective glass should be sufficiently dense to reduce the light intensity to a value not objectionable to the eye and at the same time the area immediately around the arc should be sufficiently clear to enable the operator to properly follow the work. Different color combinations are used but the most general seems to be a combination of red and green glass.

The glass is held in a recess in the front of the mask by means of a clamping frame so that the light from the arc cannot pass through joints or cracks around the edge of the glass, as a small amount of light coming through one of these openings would in a short time affect the eyes of the operator.

It is advisable to keep a piece of clear glass on the outside, since, in welding, this outside surface will be struck by particles of molten metal, and will become roughened to such an extent that it becomes useless and must be replaced.

A hand shield is principally used in doing metallic electrode welding. It consists of a light wooden frame with provision for a protective glass window similar to that used in the mask. The shield is also used by inspectors and others who require the protection only for short periods and at infrequent intervals. A light box frame surrounding the window is fitted to the operator's face, preventing light from the side or rear reaching the operator's eyes, thus eliminating any interference of a number of operators due to the light from the arcs. The protective glass of the hand shield is supported in guides on the front of the shield and is clamped in place by a wooden wedge driven through openings in the guides.

ELECTRODE HOLDERS

The function of the electrode holder is to electrically connect the electrode to the cable connected to the welding equipment. The requirements of this service are: It must securely grip the electrode so that the welder can operate it without play in the mechanism or without the electrode becoming loose in the holder while in use; the clamping arrangement should be such as to facilitate changing electrodes; it should be so constructed that the minimum heat reaches the operators' hand; the weight should be as low as possible and the balance such as to facilitate manipulation by the operator; the construction should be such that the operating parts are protected from accidental contact to avoid injury by burning or by being struck, and the general construction should be substantial to avoid bending or jamming.

ELECTRODES

Carbon electrodes should be rods of hard, homogeneous uncored and uncoated carbon. The diameter used will vary with the current to be used and this information is given elsewhere. The length depends on the particular class of work to be done. Long carbons reduce the percentage of short ends thrown away, but are more liable to breakage. The average lengths range from 9 to 12 in.

For welding iron and steel the metallic electrode should be a high grade of low carbon steel wire. A large number of tests were made by the Emergency Fleet Corporation to determine the best chemical analysis of wire for this purpose, and the wire now made by a number of manufacturers meets these requirements. This material can be purchased either direct from the makers or through jobbers and can be obtained either in rolls, or in short lengths cut and straightened. In ordering, "electric welding wire" should be specified, since wire for acetylene welding is often treated in such a way as to render it unsuitatble for electric welding.

The electrode wire should be cut into pieces convenient for the operation. A length of 18 in. is satisfactory since it is about the greatest length an operator can handle, and at the same time it reduces to a minimum the number of times the electrode is changed, and consequently the wastage.

CABLES

On account of the intermittent nature of the work it is possible to use smaller cable for the welding circuits than is standard for the current capacities. In this way, there is also a gain in flexibility which permits better control of the welding arc, by facilitating the manipulation of the electrode holder.

In metallic electrode welding a length of at least 15 ft. of extra flexible cable should be connected to the electrode holder to allow the operator to fully control the arc through manipulation of the holder. For the ground or return cable the standard extra flexible apparatus or dynamo cable insulated with varnished cambric for low voltage circuit and covered with double weatherproof braid has been found suitable.

The carbon electrode welding arc is not as unstable as the metallic arc and therefore the manipulation of the electrode is not so important. For this reason the standard extra flexible dynamo cable referred to above may be used for connection to the electrode holder, as well as for the return circuit.

It is difficult to give universally applicable figures covering amperes, speed, etc., for electric arc welding, due to the effect of conditions under which the work is done, the character of the work, and to a very large extent the skill of the operator.

The following figures are based on favorable working conditions and a skilled operator. However, they are approximations only and are given here merely as a general guide.

Current Required for Metallic Electrode Welding

Light work	25 to 125 Amperes
Heavy work	up to 225 Amperes

Electrode diameter, in.	Amperes	Plate thickness, in.
1/16	25-50	up to 1/16
3/32	50-90	up to ¼
⅛	80-150	⅛ to ⅜
5/32	125-200	¼ up
3/16	175-225	⅜ up

The same size electrode may be used with various thicknesses of plate, but the heavier plate will require the use of the heavier currents.

Approximate speeds of welding sheet metal with the metallic electrode are given in the following table:

Thickness of plate	Speed, ft. per hour	Cost per ft.	Comparative cost per ft., acetylene
1/16	20	2.12	1.78
⅛	16	3.12	4.66
¼	10	7.13	13.1
⅜	6.5	12.3	36.1
½	4.3	19.8	much higher
¾	2.0	41.7	much higher
1	1.4	61.3	much higher

The above figures are based on average figures for materials and labor. They will probably vary considerably for different localities, and will vary slightly with the type of equipment, but the relative costs of gas and electric welding will in general hold true.

CARBON ELECTRIC WELDING

The carbon electrode can be used for welding and for building up metal in a large number of cases where the metal is not subjected to high strains or where it is under compression only. This process can also be used to a very large extent in rough cutting of plates and in cutting away parts of structures.

The average current ranges for different types of work are as follows:

Light welding	150 to 250 amperes
Medium welding	250 to 350 amperes
Heavy welding and medium cutting	400 to 600 amperes
Very heavy welding and heavy cutting	600 to 1,000 amperes

The maximum values of current permissible for the carbon electrodes are as follows:

Diameter of electrode	Maximum amperes
¼ in.	100
½ in.	300
¾ in.	500
1 in.	1,000

Graphite electrodes permit the use of somewhat higher current densities but the higher cost of graphite electrodes is a serious handicap to their use. Lower currents than those given may be used, but higher values will result in undue burning of the electrode.

For depositing or building up metal, by means of the carbon arc, or flat surfaces where the work is accessible and all conditions favorable, the following figures may be used:

Current, amperes,	Lb. per hour	Cu. in. per hour
200	1½	5.4
300	3	10.8
400	4½	16.2
500	6	21.6

For continuous work the above figures may be used, but for short jobs of ten minues or less the rate will be double the amounts given.

DEPTH OF CUT FOR WHEEL LATHE

BY J. E. OSMER

A convenient method of determining the depth of cut for a wheel lathe is in use at the Owosso shops of the Ann Arbor Railroad.

The wheel or tire is placed in the lathe and the nose of the tool forced against the tread at the lowest point of the contour. The side of the crosshead and carriage is then

Flange	Thick	Depth of Cut
3/4"	"	20/32
13/16"	"	18/32
7/8"	"	16/32
15/16"	"	14/32
1"	"	12/32
1 1/16"	"	10/32
1 1/8"	"	8/32
1 3/16"	"	6/32
1 1/4"	"	4/32
1 5/16"	"	2/32
1 3/8"	"	0

Measure Thickness of Flange 1/4" Above Tread.

Turn Tire Having Thinnest Flange First. And Tire from Left Main Second, as this Last Mentioned Tire is the One that Develapes a Flat Spot, Due to the Slip of Wheel, When Piston is in Extreme Foreword Position on Left Side

Table Showing Depths of Cuts for the Wheel Lathe

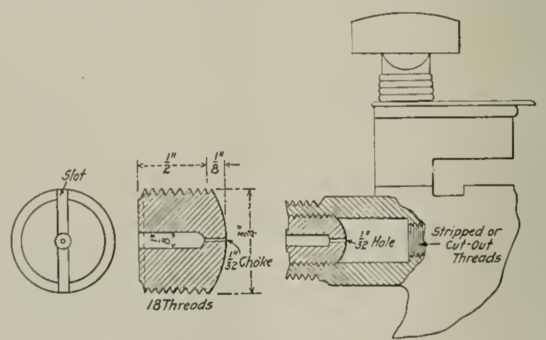
chalked and the position marked with a sharp lead pencil. The tool is then withdrawn, moved to the edge of the tire and the cross slide extended forward to the pencil mark. To this is added the depth of cut as indicated in the appended table, thus giving the total depth of roughing cut required.

REPAIRING LUBRICATOR CHOKE PLUGS

BY F. W. B.

The threads in the body of a bull's eye lubricator which take the choke end of the reducing plug, when stripped or cut out by steam are sometimes very difficult to repair. A practical improvised method of making such repairs is shown in the sketch.

The inside of the plug recess will take an 18-thread, ¾-in. tap and clean up with a satisfactory thread; it is necessary to tap it back for only about ⅝ in. The plug, which is also



Method of Repairing Bull's Eye Lubricators with Stripped Choke Plug Threads

shown in the sketch, is made and screwed firmly into this threaded recess. A slot can be sawed in the outer end of the plug to permit the use of a screw driver to put it into place or remove it for cleaning. The plug hole in most cases will be found sufficiently large for the tap, yet small enough to make no difference in the size of the oil pipe tail piece joint. This method of making repairs has been used in a number of cases by the writer with very satisfactory results.

Jacobs-Shupert Firebox Repairs

The Methods and Tools Used to Repair the Stay Sheets and Cracked and Distorted Sections

BY H. LOUIS HAHN

THE most common defects which first develop in Jacobs-Shupert fireboxes, are cracks in the inside firebox sections. They generally develop where the most heat is concentrated and are from one to six inches in length. On some engines in certain territories as many as 100 cracks have developed during the periods between shoppings. In other territories there are boxes of this type which have given seven years' service without developing any cracks of this kind.

A method of repairing these cracks, as shown in Fig 1, has been used very successfully and is now the standard method of repairing cracked firebox inside sections. A piece of the section large enough to include all of the cracks in that particular part of the section, is cut out as shown at *A*.

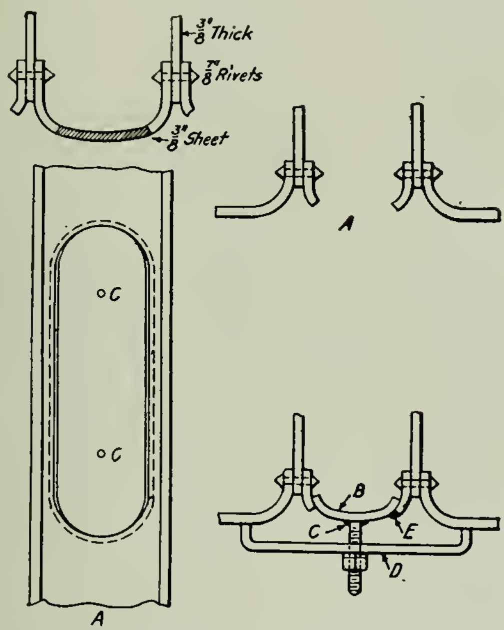


Fig. 1—Method of Patching Firebox Sheets

A patch of 5/16-in. firebox steel is then formed to fit on the inside of the section, as shown at *B*, lapping over the inside ¼ in. all around. To facilitate the handling necessary to make a good fit of the patch, one or two ¾-in. bolts six inches long, having had the heads sheared off, are welded to the patch as shown at *C*. Only one bolt is necessary for a short patch, but on long patches they should be spaced about 12 in. apart.

After the patch is properly fitted, the clamp or clamps *D* are applied to hold the patch in the proper position while it is welded in by either the gas or electric process. The edge of the old sheet is welded to the new patch as shown at *E*. The ends should be welded first and the sides last, as the curved surface of the sides will compensate the strains due to contraction of the cooling welds more easily than the ends. As much of the welding as possible is done with the clamps *D* in position. The writer has applied patches up to 48 in. in length, welded with the gas torch, which have been running two years without any leaks developing. The same method is used for cracked sections on the curve of the crown sheet side roll. In the center of the crown sections defects arising from low water, such as stretching of the sections, are repaired in the same manner. These patches meet the requirements and approval of the Interstate Commerce Commission Division of Locomotive Inspection.

The first solid stay adjacent to and on each side of the center sling stays will develop cracks under the top outside sections, as shown at *A* in Fig. 2, after the firebox have been in service. The method of repairing such cracks consists of flanging ⅜-in. brackets *B* and riveting them to the outside sections as shown, using bolts to fasten the brackets to the stay sheet.

A very common defect is the cracking of outside top sections through the center line of the rivet holes, between the holes. Cracks develop first in the section adjacent to the throat sheet connection sheet and in succeeding sections back to and including the fifth section, in some cases, as shown in Fig. 3. A number of years ago when these cracks first developed it was thought that they were the result of anchoring the backhead braces on lugs riveted to these sections. After the cracked outside sections were renewed braces were anchored ahead on the throat sheet connection sheet as shown in Fig 3 and flexible flue sheets applied. These same renewed sections are developing cracks in the same places as the original sections and necessitate the renewal of the part sections previously applied.

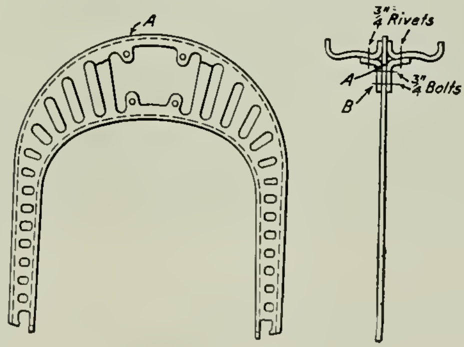


Fig 2—Stay Sheet Repairs

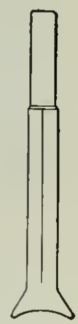


Fig. 5—Scale Tool

The defective parts of the sections are removed, the new part sections are fitted and the joints are butt welded to the old portion of the sections with the gas torch.

When any part of the inside sections become defective and cannot be repaired as shown in Fig. 1, the method shown in Fig. 4 is used. A portion of the outside section opposite the defect in the inside section is cut out and the edges chipped bevel. The cutting torch is used to remove the piece, but where this is not available it may be cut out with an air hammer and chisels.

After the cracks in the inside section, or whatever other defects there may be, are repaired, the piece of the outside section which was removed is fitted in place, beveled, welded and riveted and caulked. This method may be used for any part of the outside sections. The object of the diagonal cut is that, during the operating of welding the piece in again, there will be no strains resulting from cooling welds, the line of contraction being horizontal instead of vertical. The same method of the diagonal cut is now followed in applying new top sections as shown in Fig. 3.

A defect which often develops soon after these fireboxes go into service is the cracking of door sheet and flue sheet stay sheets in the right and left water legs, adjacent to the outside sections. These cracks start in the corners of water circulation cut-outs and gradually run upward and downward at an angle of about 15 deg. until they meet and form one continuous crack. They can readily be discovered by holding a flash light in the corner washout plug holes just above the mudring.

A method of repairing the door sheet stay sheet is to cut the backhead sheet between the first two vertical rows of staybolts high enough to remove a piece of the side roll of the backhead from the mudring up, so that the defective portion of the door sheet may be uncovered. Then either chip out the cracks in the door sheet and weld them, or apply a

Fig 3—Defective Outside Top Sections Removed

new piece of door sheet and weld it in. After the repairs to the door sheet are made, replace the piece cut out of the backhead sheet, first applying it with temporary bolts, then weld the butt joint and then rivet and caulk the sheet at the mudring.

For flue sheet stay sheet cracks in the side water legs the method of repair where a new sheet is not necessary is shown in Fig. 4. Cut out a piece of the outside section and weld the cracks in the stay sheet. When it is necessary to apply a new flue sheet stay sheet, the firebox back end is disconnected at the throat sheet connection rivets and the back end loaded on a car to facilitate handling. The flue sheet, including the defective portion in the side water legs is removed and the new sheet laid out, punched and applied When a flue sheet stay sheet only is applied to the back end, it is not necessary to remove the outside section to drive rivets in the inside section; a holding on bar is used instead. This bar is bent on the end and made small enough to go through the water circulation cut-outs. Rivets are then applied from the rear side of the flue sheet and driven from the front side. After the flue sheet is riveted to the firebox section, the firebox back end is raised and reapplied to the boiler at the throat sheet connection and riveted and caulked. An alligator hydraulic riveter is used to apply rivets in the outside section, but it is possible to countersink the holes and drive the rivets with an air hammer. One firebox had three new outside top sections, a new flexible flue sheet and a new portion of staybolt section of flue sheet stay sheet applied at the same shopping.

To renew a complete inside section, start at the flue sheet end and remove stay sheets and both outside and inside sections, one at a time, until the defective section is reached. Remove one more outside section than the number of inside sections, so that the riveting machine can be brought to the work to rivet the new inside section after it has been fitted. Then fit up the old inside sections and stay sheets, applying them in the same order as removed, so that the stay sheets

Fig. 4—A Method of Repairing Inside Sections

and sections will be in the same relative position as before. Next apply rivets to all of the inside sections, using an alligator riveter. Then fit up and reapply all outside sections in their proper place and rivet and caulk. The completed back end can then be reapplied to the boiler and the throat sheet connection riveted and caulked.

In laying out and punching any water circulation cut-outs in stay sheets, care must be exercised to have round corners, as square corners will crack out much sooner.

The Jacobs-Shupert firebox will accommodate itself to longitudinal strains due to the inequalities of the firebox and outside casing sheet expansion, but will not accommodate itself to transverse strains from the same cause. Each section being of a semi-circular shape will take care of accumulated longitudinal expansion, but the transverse rigid stay sheets will permit of no equalization of the vertical or transverse stresses which occur, especially during the operation of firing up cold boilers. These strains and stresses first cause the inside sections of fireboxes to crack and as they develop further the strains are communicated to the transverse stay sheets, causing the cracks as shown in Fig. 2 where the stay sheets come in contact with the outside sections. These same stresses also cause cracks at the door sheet and flue sheet in the side water legs.

This style of firebox tends to travel upward in service, this being proved by the fact that it is necessary periodically to inspect the two center rows of sling stay straps in the crown section. On removal of these straps after the firebox has been in service it will be noted that it is a very difficult matter to remove the supporting bolts, due to compressive strain on the sling stay straps. Often, when replacing the same straps in the same position it is noted that they are from 1/32 in. to 5/64 in. too long, thereby necessitating the making of new straps.. This compression, on the solid stays next to the center sling stays at the front end of the firebox at the flue sheet is enormous and being communicated to the outside sections is the cause of cracks in the outside sections, necessitating their removal, as shown in Fig. 3. In the writer's opinion the only way to prevent the cracking, and the resultant necessity of renewal of outside top sections, is to design the Jacobs-Shupert fireboxes with at least an 18 in. combustion chamber in front between the firebox and the tube sheet.

Scale will not accumulate to any great extent in the center of the firebox sections, due to their constant expansion and contraction. A heavy scale will collect on and adjacent to the rivet heads of the connection of the firebox sections to the stay sheets and this needs attention and should be frequently removed.

The tool shown in Fig. 5 used in connection with a small air hammer has proved very effective in removing this scale. This tool is passed rapidly over the fire side of the section along the stay sheet caulking edge, thus jarring loose the scale on the water side of the section. The cleaner the firebox sections are kept, the better the results will be and the cracking of the inside sections can be reduced somewhat by keeping the scale formation at a minimum.

The water and fuel conditions enter more largely into the question of sustained service of Jacobs-Shupert fireboxes than in the standard staybolt types. With good water, and coal as fuel, the Jacobs-Shupert firebox will give from two to three times the service of the standard staybolt type, but with oil as fuel and when operated in bad water districts, it will give only one-fourth the service of a firebox of the staybolt type.

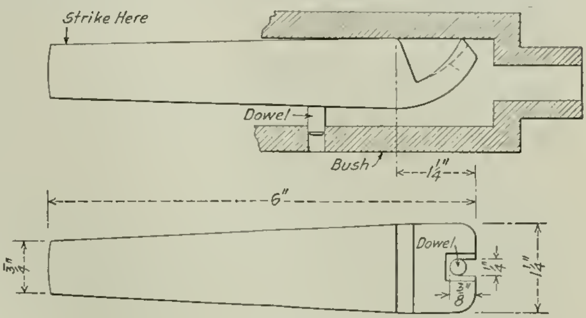
From a safety standpoint, the Jacobs-Shupert firebox is, at the present time, the most perfect form of locomotive firebox. Because of its sectional construction it is impossible to explode one of these boxes. The worst that has happened, in a number of instances, is the overheating and consequent stretching and the ultimate bursting of one of the crown sections.

Due to the fact that it is practically impossible to explode one of these fireboxes, enginemen handling them will sometimes run long distances with no water in sight in the glass. This practice causes crown sections to overheat and pressure stretches them to a semi-circular shape. In removing the flues at shoppings it is often found that in the second row from the top the flues are distorted and sometimes are collapsed from this cause. Particular care should be used in setting water glass and gage cocks on this type of firebox so that the maximum amount of steam space without the sacrifice of safety may be obtained.

REMOVING DOWEL FROM AIR PUMP REVERSING VALVE BUSHINGS

BY J. A. JESSON

In the article describing a method of repairing worn reversing valve bushings of 9½-in. air pumps, which appeared on page 210 of the April issue of the *Railway Mechanical Engineer*, no method for removing the dowel was shown. The accompanying sketch shows a single tool that will both extract and replace the dowel in a very simple manner. It consists practically of an elongated claw hammer without the handle hole. The claw is driven over the dowel, its



A Tool for Removing and Reapplying Dowels in Reversing Valve Bushings

sharp edges forming a grip in the soft metal; tapping the end of the tool pulls out the dowel in the same manner as pulling a nail.

To replace the dowel, start it in the hole, then place tool in position, as shown, and force the dowel in by striking the end of the tool. By this method all work is done from the inside of the bushing. The plug in the body need not be disturbed.

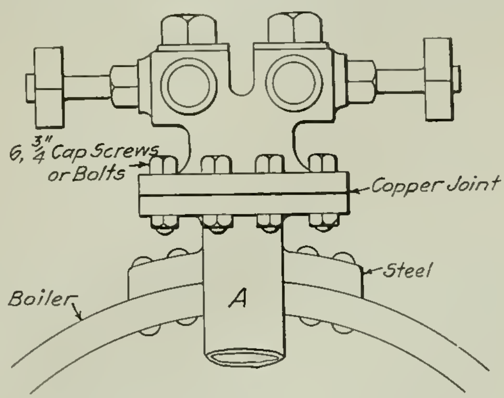
An old drill shank will make a good tool, care being taken to round off that part that bears against the bush while replacing the dowel.

A BOILER CHECK CASING WITH GASKET JOINT

BY J. H. HAHN

Night Machine Shop Foreman, Norfolk & Western Railway, Bluefield, W. Va.

The sketch shows an improved boiler check casing which was designed by the writer to overcome the trouble caused by the ordinary type of boiler check casing leaking at the



Boiler Check Casing With Special Fitting

joint where it is bolted to the boiler, as was the case with the older designs. Considerable trouble is often experienced with the check casings that bolt to the boiler direct and use a ball joint ring, but with the type of check casing shown in the sketch there is little or no possibility of the casing leaking.

This boiler check casing is provided with a flanged joint and bolts on the special fitting *A*, which is riveted to the boiler shell. A gasket is placed between the flange and the fitting *A*, thus insuring a tight joint.

Any check casing of the ball joint ring type can be converted into the gasket type by simply adding one of the special fittings and bolting the check casing to it as shown. A slight change in the branch pipes may be necessary because the fitting *A* raises the check casing slightly higher than is necessary when it is connected to the boiler in the usual manner.

AUTOMATIC SELF-DRAINING GLOBE VALVE

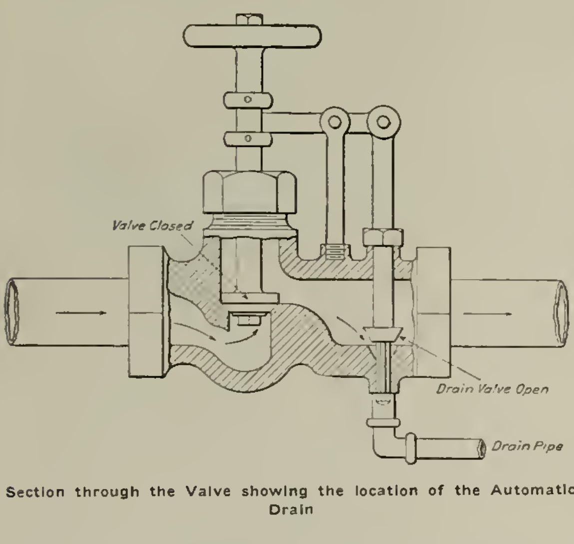
BY J. H. HAHN
Night Machine Shop Foreman, Norfolk & Western Bluefield, W. Va.

The globe valve shown in the sketch was designed to eliminate the liability of damage to air pumps, stokers, electric turbines and generators, etc., due to freezing in the winter time. It prevents the accumulation of condensation in pipes where it is not desirable.

The valve is of the usual globe valve design with an automatic or self-operating drain valve attached. When the globe valve is closed the drain valve is opened, the collars on the globe valve stem engaging the lever as shown, which in turn operates the drain valve which is contained in the valve body. When the globe valve is opened the drain valve is closed in the same manner.

This self-draining valve will save much of the additional piping necessary in putting in tees and drain valves of various kinds that depend upon the human element for their operation. With one of these self-draining valves applied in the steam line to a cross-compound air pump, all the drain cocks that are now used to drain off the condensation could be dispensed with.

On cold nights in the winter when the locomotive is in the roundhouse dead the probability of the drain valve being left closed is great, but with this self-draining device danger of freezing is eliminated.



Section through the Valve showing the location of the Automatic Drain

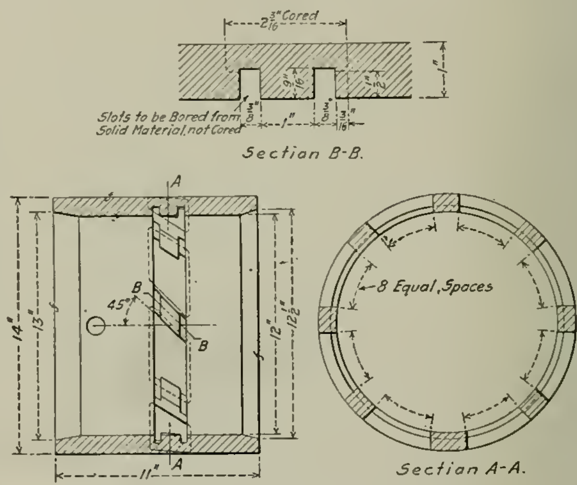
A SPECIAL VALVE BUSHING DESIGN

BY L. P. MICHAEL
Chief Draftsman, Chicago & North Western, Chicago

A valve bushing which the writer has had designed and which has been adopted as standard on the Chicago & North Western is shown in the drawing.

The special feature of this valve bushing is the method used in coring the steam port openings. These cored openings are made of such shape that the edges of the steam port can be finished in the boring mill or lathe at the same setting used for boring out the bushing.

This saves considerable time and labor, as the port edges are usually finished on either a milling machine or draw-cut shaper. The finishing of the port edges can be done in the lathe or boring mill by cutting a groove for each port edge. The groove is 3/8 in. wide and the packing ring is of tee shape, 7/8 in. wide over the head of the tee, which gives a bearing of 1/2 in. when the ring is over the finished port groove.



Method of Coring and Finishing the Ports

A bushing of this design not only can be finished with less time and expense than the ordinary bushing, but it also gives the advantage of a considerably larger port opening, especially at short cut-offs.

Heat Value of Fuels.—Tests of the heating values of fuels have become of great commercial importance, as practically all coal sold on large contracts is paid for on the basis of the heating value found in the tests conducted by or for the purchaser. The instrument used for carrying out this test is the bomb calorimeter, which comprises a strong, steel cartridge or capsule with a removable cover, adapted to contain a small charge (about 1/30 ounce) of coal. The bomb is tightly closed and oxygen is introduced under high pressure. It is then put into a calorimeter, the coal ignited electrically, the heat generated being absorbed by the water. The quantity of heat liberated in the combustion of the fuel is then calculated from the rise in temperature of the water. Important aid has been given in the standardization of the testing of coal for calorific power by the issuance by the Bureau of Standards samples of materials of accurately known heat values which afford a simple, precise, and convenient means by which the user of the calorimeter may check up the accuracy of his own determinations.—*Technical News Bulletin, Bureau of Standards.*

Modern High Speed Tool Steel*

The Origin and Development of Modern High Speed Steel; The Hardening and Tempering Qualities

BY JOHN A. MATHEWS

After accepting the invitation of the Committee on Papers and Publications to present a paper on the announced subject, the writer began to wonder just what the Committee meant by "Modern" High Speed Steel. A product that is of less than twenty years' standing is certainly modern when compared with crucible tool steel which has been manufactured for about 170 years, and even the air-hardening steels which preceded high speed steel resulted from the investigations of R. F. Mushet about fifty years ago.

I have been deeply interested in everything pertaining to the history of the iron and steel business, but this latest product, high speed steel, seems to have sprung fairly fully developed from a variety of sources and at almost the same time, and I have been unable to show just when the change from the old type of air-hardening steels to the modern type of high speed steels took place. Obviously the change is associated with the announcement of the Taylor-White process; that is, the high heat treatment given these grades of steels as compared with the ordinary treatment of carbon tool steels. This process was announced at the close of the nineteenth century, and the results of the Taylor-White process were demonstrated on a large scale at the Paris Exposition in 1900.

Notwithstanding the fact that the originators of this process took special trouble to disclaim the invention of a steel, but only a process for treating steel, a large number of workers in steel still seem to feel that they were the inventors of the product known as "High Speed Steel." Mr. Taylor, in his epoch-making paper on the "Art of Cutting Metals," very plainly states that this was not the case, and most users of steel have forgotten that the type of steel to which this treatment was first applied was the high-carbon air-hardening steel used prior to 1900.

The change from air-hardening to high speed steels was rather a matter of evolution than a distinct invention, and I have not been able to ascertain that the change was the result of any one man's discovery or invention. Chemically the change consisted in a very radical lowering of the carbon content and a great increase in the tungsten or molybdenum content. The chromium percentages have not been materially altered as compared with previously existing air-hardening steels; but high manganese, which was an important constituent of the original Mushet steel, is not now an important constituent in high speed steel; in fact, chromium replaced manganese in most of the air-hardening steels during the later years of their use in the nineties.

In 1901 the writer collected a number of the typical analyses of air or self-hardening steels from large users of these products. In 1902 our analyses showed that the change had already taken place in America, England and Germany, and the contrast is illustrated in Tables I and II. Each table contains products of the three countries mentioned, but the exact maker is not designated.

The high carbon content and the low tungsten or molybdenum content in Table I indicates the character of air-hardening steels in use prior to 1901.

In Table II, although these analyses were made only one year later, it is seen that a change in character has come about, and relatively low carbon, with high tungsten or molybdenum, is the characteristic feature of the new steels.

It will be noted that two of the steels in Table II, one a molybdenum and the other a tungsten steel, contain no chromium.

It should be borne in mind that during the later days of air-hardening steels and the earlier days of high speed steels, it was a difficult matter to produce low carbons with the available ferro-alloys. The introduction of electric furnace and alumino-thermic alloys had much to do with the success of manufacturers in keeping their carbons down, but the idea that they should be reduced and that the alloys might be increased in conjunction with the application of a high heat treatment seems to have been almost spontaneous with the makers of tool steel in every country. In my search for the definite origin of this idea I learned of a user of steel who in the early days of the Taylor-White process obtained some extraordinary results with a particular bar of the old Sanderson self-hardening steel. Upon analysis it developed that this particular bar was considerably lower in carbon than usual, and instead of reporting this fact to the maker, he gave a sample of the steel to the representative of a foreign mill.

Table I—Self-Hardening Steels, 1901

Maker No.	Carbon, per cent	Manganese, per cent	Chromium, per cent	Tungsten, per cent	Molybdenum, per cent
1	2.19	1.32	0.50	5.63	....
2	1.69	0.45	3.73	7.63	....
3	1.14	0.33	2.09	7.98	....
4	1.79	0.50	3.96	....	4.54
5	1.55	0.24	3.22	7.80	....
6	1.55	0.21	3.67	9.42	1.10
7	1.78	1.18	....	7.22	....
8	1.40	1.65	3.69	....	4.59
9	1.75	3.92	....	6.61	....

Table II—High Speed Steels, 1902

Maker No.	Carbon, per cent	Manganese, per cent	Chromium, per cent	Tungsten, per cent	Molybdenum, per cent
21	0.63	....	4.00	....	6.00
22	0.42	....	4.95	10.75	....
23	0.57	0.43	3.30	11.58	....
24	0.75	....	....	19.50	....
25	0.37	....	5.10	13.83	....
26	0.62	....	6.50	21.06	....
27	0.84	0.07	2.76	11.25	....
28	0.56	....	2.95	9.74	....
29	0.60	0.30	....	....	9.25

My former associate at the Sanderson Works, Dr. E. L. French, is on record, however, as having predicted prior to 1900 that the tendency would be to rely for hardening upon tungsten and chromium rather than upon carbon in order to secure the kind of hardness which resists tempering—in other words, the peculiar red hardness upon which high speed steels depend.

It is probable that we shall never know who took the radical step and made the first low-carbon, high-tungsten high speed steel, but immediately following the announcement of the Taylor-White process there was great activity on the part of all tool steel makers in every country to produce a product which would yield maximum results when treated by this process. The courts decided that Messrs. Taylor and White did not make a patentable invention or discovery. A world jury, however, seemed to differ with this decision and every scientific honor was awarded them for their epoch-making announcement which revolutionized machine-shop operation and machine-tool building.

With the development of high speed steels there has been much study devoted to them from many angles. The engineer, the machinist, the chemist and the metallurgist have all been interested, and much has been said and written in regard to

* A paper presented at the Twenty-second Annual Meeting of the American Society for Testing Materials, held at Atlantic City, N. J., June 24-27, 1919.

this remarkable product. The question to be answered by all investigators of high speed steels has been: What constitutes the most efficient cutting tool and why? In Mr. Taylor's work "The Art of Cutting Metals," the point of view of the machine-shop economist is most ably presented. His work records the development of a high speed tool in regard to its composition, its heat treatment and the method used to secure the most economical removal of metal. The peculiar property of these steels in resisting softening in use Mr. Taylor has called the "quality of red hardness," and he makes no attempt to connect red hardness with any of the previously known physical properties of metal. The only method of measuring this quality of red hardness known to Mr. Taylor was the very expensive and time-consuming resort to cutting tests. The necessity for shorter and more easily applied tests was appreciated by Mr. Taylor, for he says, referring to cutting tests: "This test requires so much expensive apparatus, consumes so much time and is so slow, that a simpler index or guide which will indicate correctly the quality of high speed tools is much needed. Moreover, we firmly believe that in time some simpler index to the property of red hardness in tools will be found."

Accepting this suggestion, many able scientists have conducted investigations upon the hardening and tempering qualities of high speed steels of many compositions, and also in connection with the study of the specific functions of the various elements entering into their composition. I might mention specifically the work of Dr. H. C. H. Carpenter upon the types of steel and critical ranges of heating and cooling of high speed steels under varying thermal treatment, and also upon the tempering and cutting tests of high speed steels. The writer took a special interest in these investigations because of the fact that he had the pleasure of furnishing Dr. Carpenter many of the alloys used by him, taken from materials used in his early investigations in this country.

It may be taken for granted that any one interested in the scientific study of high speed steel will study Mr. Frederick W. Taylor's work upon the art of cutting metals. Dr. C. A. Edwards has studied the function of chromium and tungsten in high speed steels, and in conjunction with Mr. H. Kikkawa, published a later paper upon the effect of chronium and tungsten upon the hardening and tempering of high speed tool steel. Particular attention should also be given to the papers by Prof. J. O. Arnold and A. A. Read upon the chemical and mechanical relations of iron and carbon when associated with tungsten, molybdenum, chronium and vanadium. Each of these elements has been taken up one at a time in its relation with iron and carbon.

Dr. Carpenter, in studying the heating and cooling curves of tungsten and molybdenum products, finds the effect of these elements to be, first, the widening, splitting and lowering of the critical ranges by the special alloy elements; second, the complete suppression of the widened, split and lowered range by rapid quenching. He found also that these steels so hardened were in the austenitic condition and showed no signs of tempering when reheated below 500° C. and in some cases to even higher temperatures. Carbon steels show the effects of tempering as low as 200° C. Dr. Carpenter later supplemented this investigation with another one in which he studied the effect of etching reagents upon hardened and tempered high speed steels as prepared for microscopic examination. In general he found that the higher the steel had been heated for hardening, the less slowly it was attacked by the etching reagent. Also that when fully hardened and later subjected to tempering operations, the converse was true, namely that the more fully the temper had been drawn the more easily it was attacked by the etching material.

Dr. Edwards, in his earlier paper, finds that hardness assists the efficiency of the cutting tool, referring to purely mineralogical hardness as distinguished from red hardness. He also states that chromium forms a double carbide with the tungsten and a new brittle constituent appears at about 700° C. in tempering which caused the failure of high speed tools. In his later statement, published jointly with Mr. Kikkawa, he abandons these last two positions but states that chromium in these steels in conjunction with carbon is the cause of the great hardness of high speed steels and that it produces a marked lowering in the temperature at which hardness can be effected. He differs with the earlier conclusions of Dr. Carpenter that chromium does not confer the quality of air hardening in the absence of tungsten or molybdenum, but that chromium steel so hardened in air develops a comparatively slight degree of secondary hardening or "red hardness," as Taylor designated it.

In regard to high tungsten steel in the absence of chromium, he finds that a large proportion of the tungsten remains undissolved even when the temperature is raised to the melting point, and agrees with Arnold and Read that this tungsten is probably in the form of a tungsten iron compound, Fe_2W. Very rapid quenching from high temperatures results in much less hardening than is obtained from a high chromium steel similarly treated; but the tungsten steel, on tempering, undergoes a very pronounced secondary hardening—in other words, it is the tungsten which confers the quality of red hardness. While Dr. Edwards, in his investigation, did not cover a study of molybdenum, we can say that molybdenum in its effects is very closely analogous to tungsten and about twice as efficient; that is, an amount of molybdenum confers a degree of red hardness similar to or greater than twice its weight of tungsten. The difference between these two metals seems to be one of degree rather than of kind. When chromium and tungsten are present together the presence of the chromium increases the solubility of the tungsten when raised to high temperatures. Dr. Edwards states that the maximum of resistance to tempering and the greatest degree of secondary or red hardness is obtained by getting the tungsten into complete solution, and in modern high speed steels he places this temperature at about 1350° C. (2462° F.). In our experience this temperature is too high for practical results and is apt to result in brittleness, and also, as will be shown later, the hardness seems to decrease rather than increase upon extreme over-heating to such a temperature, and at this temperature there is formed a so-called "brittle constituent," to which Dr. Edwards refers in his first paper. This constituent is due solely to over-heating and is not produced when tempering at 700° C. (1392° F.) in properly hardened high speed steel.

Dr. Edwards also points out very clearly, and shows by his results, that this secondary hardness by drawing the temper may be and usually is actually greater than the initial hardness of the hardened high speed before the temper has been drawn at all, but that at intermediate drawing temperatures there is some lowering of the hardness, which later increases as we approach the temperature at which full annealing begins. The temperature at which he finds the maximum secondary red hardness coincides almost exactly with the temperature given by Taylor as that recommended for the second heat treatment required in the Taylor-White process, for, as described by Mr. Taylor himself, the second heating of the hardened tool consists of heating the tools "(*a*) to a temperature below 671° C. (1240° F.), preferably to 621° C. (1150° F.) for about five minutes; (*b*) cooling to the temperature of the air either rapidly or slowly."

As previously reported to this Society, in a paper entitled "Magnetic Habits of Alloy Steels," the writer began some fifteen years ago to study systematically, and as a matter of routine, the magnetic properties of practically all the alloy steels manufactured in our regular line of business. That paper did not touch upon any magnetic work in conjunction with air-hardening or high speed steels, but such work was commenced in the earliest days of the modern high speed steel, and renewed attention was given to this matter after the suggestion of Mr. Taylor that a simpler index or guide to the quality of high speed steels would be of great use and importance. A paper on the subject of the physical characteristics of high speed steel was promised for presentation at the last meeting of the International Association for Testing Materials held in New York in 1912. At that time the work was not sufficiently advanced to permit of presenting the results, and, in fact, even yet the results are not what we had hoped to obtain from this long continued study. It was thought that there might be found some critical temperatures in connection with the magnetic or electrical resistance of high speed steel which would furnish a definite indication of its properties at those temperatures most suitable for commercial hardening. In addition to magnetic and resistance tests of various high speed steels hardened and tempered in a wide variety of ways, we have supplemented the work with microscopic examinations, and to some extent by cutting tests.

While in the aggregate a great variety of high speed steel compositions have been tested, not only of our own regular and experimental steels, but also commercial steels of a great many brands foreign and domestic, the greater part of the systematic investigation was confined to four steels, the analyses of which are given in Table III. These steels cover quite a range as regards their chromium, tungsten and vanadium content. Steel No. 31 represents a type which was fairly generally used about ten years ago; in fact, various writers as the result of practical tests, have contended that tungsten above 13 or 14 per cent is of no advantage. Practical experience, however, has led for the most part to higher tungsten percentages.

Steel No. 34 is introduced because it corresponds quite nearly with the analysis of steel to which Mr. Taylor referred as giving the best results obtained with any steel at the time he was actively engaged in this work. In fact, because of Mr. Taylor's recommendation, steel of this character was once adopted as the standard material desired by the Navy. Their specification, however, calling for high tungsten and high chromium, was abandoned after one year because it was found that steel of the type represented by No. 33 gave materially better results.

Steel No. 32 is intermediate in quality as compared with Nos. 31 and 33. As the result of a very exhaustive series of cutting tests made as nearly as possible in accordance with the methods outlined and recommended by Mr. Taylor, these four steels will rank about as follows, starting with No. 33 as 100 per cent efficient: Steel No. 34 would be represented by 70 per cent, No. 32 by 66 per cent and No. 31 by 45 per cent.

Table III—Analyses of Four Steels Used in Tests

Steel No.	Carbon, per cent	Silicon, per cent	Manganese, per cent	Chromium, per cent	Tungsten, per cent	Vanadium, per cent
31	0.63	0.19	0.26	4.21	13.10	0.25
32	0.61	0.19	0.36	3.34	16.28	0.40
33	0.63	0 27	0.31	2.99	16.87	0.85
34	0.64	0.22	0.24	5.35	18.99	0.15

It is apparent, therefore, not only from the analyses but from the figures above, that the steels are typical of well-known commercial types of steels, and it therefore might be thought that their behavior electrically and magnetically, also as to hardness, would show marked differences, with possibly some differences in critical temperatures both in hardening and in drawing. However, this does not appear to be the case, but the following general conclusions can be stated in regard to all of them.

Starting with hardening temperatures at 982° C. (1800° F.) and carrying them up to 1315° C. (2400° F.), it would be noted that the electrical resistance, the scleroscope hardness and the coercive force increase fairly uniformly with the hardening temperature up to about 1260° C. (2300° F.). There is a slight tendency to show a reversal of these properties beyond this temperature. In other words, it would indicate that overheating had commenced. Magnetic induction and residual density, as the hardening temperature increases, are lowered.

If these steels hardened at proper temperatures to develop full austenitic structure are subjected to the tempering operation varying from room temperature up to 649° C. (1200° F.), it is noted that there is a general falling off in the hardness, resistance and coercive force as the drawing temperature is increased. This is not quite in accord with statements that have been made that there is no effect in drawing the temper of high speed steel until the temperature of 500° C. (932° F.) has been reached. It is true, however, that the effect upon these properties is only slightly influenced below this temperature, while the rate of change increases fairly rapidly at temperatures above 482° C. (900° F.). There is no indication, as regards magnetic properties, of anything corresponding to the secondary hardening referred to by Edwards, nor have we found it in connection with hardness tests made by the scleroscope. In cases where the Brinell method is used we found it very difficult to get constant results with materials so extremely hard, but with that method we have found an indication of re-hardening, or secondary hardening at high drawing temperatures, the maximum usually being at about 593° C. (1100° F.). The lower the temperature at which the initial hardening is done the lower will be the temperature at which the re-hardening occurs on tempering, and presumably the sooner a tool so treated would fail in severe cutting where the frictional temperature was high. When the temperature in cutting is not extremely high we cannot conclude that the steel would fail sooner than one with a higher re-hardening temperature. In such cases, in my opinion, physical or mineralogical hardness plays an important part as distinguished from red hardness, but where the cutting conditions are severe it would appear logical that the higher the temperature of red hardening the longer the endurance of the tools.

The tests that we have made were for the most part made upon hot rolled 1-in. by 5/8-in. bars in just the condition that might have been used for cutting tests or for supplying to users. After all heat treatments, however, the surface was examined by file testing to see that no unreasonable decarbonization had taken place. There was, however, some slight decarbonization of surface in all cases, undoubtedly due to scale and oxidation. However, we wished to operate under conditions as nearly as possible those that would obtain in practical work in case it were found possible to make use of physical tests rather than cutting tests as a means of judging the relative merits of high speed steels. Of course for determining hardness it is necessary to remove, by grinding, sufficient material to get below any possible decarbonized or oxidized zone.

We are convinced that to make these tests with scientific accuracy would require conditions of heating and temperature control much more refined than are usually found in industrial plants and that it would be desirable to operate on round pieces which could readily be rough turned prior to any treatment and ground on centers after each treatment to insure making the test on perfectly sound material. This, in my judgment, removes such methods from the kind of tests that Mr. Taylor had in mind, as they introduce the same element of expense and require the expenditure of considerable time.

For purely scientific reasons it might be worth while to conduct such a series of tests on different types of high speed steel; the intervals of temperature should preferably be not over 10° C. (50° F.) both in the tests made on hardened bars and also on the tempering ranges, particularly from, say, 482° C. (900° F.) up to the point of softening. This is entirely too complicated and extensive a program to consider as a convenient substitute for the cutting tests.

To refer again to the title of the paper and what is meant by "Modern," we might call attention to the difference in analyses displayed in Tables II and III. The most noteworthy change is in the introduction of vanadium, which is now used in practically every high speed steel; in fact, it is the only general addition that has been made to the earlier types which seems to afford universal improvement in quality. The writer began experimenting with the use of vanadium in 1903, and it is well to bear in mind that at that time vanadium was almost a chemical curiosity. It was worth about $15.00 a pound, and this was some time prior to the formation of the American Vanadium Co. which manufactured and sold vanadium in large quantities. So far as the writer is aware, the entire stock of ferro-vanadium in the country when these experiments were begun consisted of not over 100 lb. in the hands of two different dealers in New York. We purchased one-half of the entire stock of each dealer. As the result of these experiments carried on at the old Sanderson Works, a patent was granted the writer, issued on January 3, 1905. Other experimenters were doubtless working with the same thing, and, in fact Mr. Gledhill referred to its use in 1904, as did also Mr. Taylor. In fact, the composition of tool steel previously referred to as giving Mr. Taylor his best results, showed 0.3 per cent of vanadium. During the year 1905 the Rex AA steel was put upon the market, and other vanadium steels followed shortly, but it was not until three years later that certain foreign makers copied this original steel exactly and made great claims as to originality in regard to their product.

As has been stated, vanadium seems to have conferred general benefit upon all tungsten-chrome or molybdenum-chrome high speed steels. In this particular it differs from other additions that have been introduced since. The use of cobalt received considerable attention a few years ago, but it was noted that it was always present as an addition to types of steels that would have given remarkably good results if the cobalt had been omitted. I have never seen anything to indicate that it could be used as a substitute for any of the other elements regularly present, and its use is not now as extensive as it was a few years ago. As an element of increased cost it has not shown sufficient improvement in the long run to warrant its general use. So far as our observations are concerned it seems to lead to some uncertainty in the manufacture and treatment of the steel, and steels containing it seem to be more difficult to re-forge or re-dress than steels in which it is absent. These comments are made notwithstanding the fact that one of the most carefully conducted competitive tests on high speed steel ever made in an industrial plant was won by a steel containing cobalt, and it might be added that there is every probability that the same steel without the introduction of cobalt would have been equally as successful.

The use of uranium has been advocated during the past few years, but it seems to be very difficult to handle owing to the ease with which it is oxidized, and so far as our experience goes we have been unable to see that it confers any specific benefit. Such steel as we have examined has been more apt to show seams and surface defects than steel in which it is absent, and the microstructure of the steel itself usually indicates the presence of considerable amounts of material that are suspected of being oxides of uranium. It should be noted that when oxide of uranium is formed in melting it has small chance of being eliminated in the slag owing to its great weight. It may be that with more experience means will be found of introducing this material into the bath without such great loss of expensive metal and without the formation of these impurities in the steel which cannot but prove detrimental.

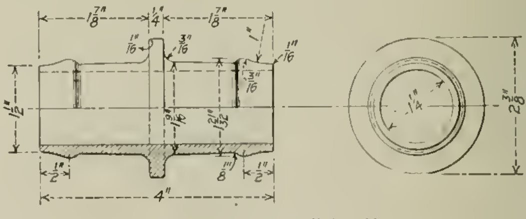
Other elements have been tried, including cerium and zirconium, but no conclusions are available as yet.

The term "Modern" High Speed Steel therefore may be considered as referring to the product since the introduction of vanadium, as no generally accepted improvement has been made in high speed steel since that time. Improvements have resulted in the general quality of the material available, due to greater skill in manufacture, and to the availability of superior raw materials in the form of metals and ferro-alloys than were obtainable in the early days of the industry. It is still a constant source of surprise to see tests conducted in which a steel that may appear of inferior analysis proves successful, whereas some other type of analysis, judged from this viewpoint only, would naturally be expected to prove the better steel. In a very elaborate series of tests, including over 50 analyses, it was noted that in those steels included in the first group as to merit the compositions vary from 12.70 to 18.59 per cent of tungsten, from 1.70 to 5.58 per cent of chromium, from 0.40 to 1.73 per cent of vanadium, and from 0.52 to 0.81 per cent of carbon. The steels rated as second and third class in general covered almost identical ranges. It therefore seems that steel making rather than chemical analysis is the first consideration, and so far we are not able to define or to specify all the elements which enter in, from the melting to the finishing of a bar, to produce first-class material in a very wide range of analyses, and no physical or chemical test has as yet been developed which helps very much in determining the matter of quality.

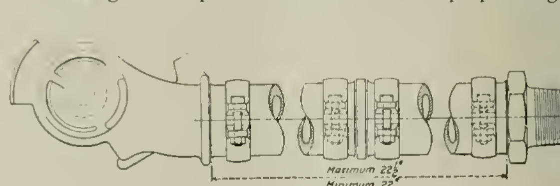
RECLAIMING AIR BRAKE HOSE

BY E. A. M.

A method of reclaiming air brake hose which is efficient and economical is illustrated in the drawings. Hose which has been cut, chafed, burst or otherwise damaged but in good condition for at least one-half its length can be reclaimed by splicing the undamaged portions as shown in the drawing. Two pieces of hose cut to the proper length are clamped to a nipple and the fittings applied at the ends of the spliced hose in the usual manner.



Special Nipple for Splicing Hose



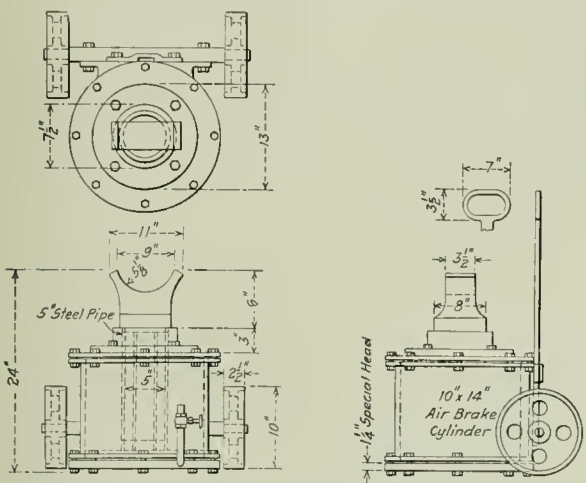
Spliced Hose with Fittings Applied

The reclaimed hose may be applied to the front end of road engines, both ends of yard engines, caboose, camp and maintenance of way cars.

AIR JACK FOR LIFTING WHEELS

BY C. W. SCHANE

The air jack shown in the drawing provides a convenient means of transferring driving wheels about the shop. The jack consists of a standard 10-in. by 14-in. air cylinder with a special head applied at the bottom so that an air pipe can be connected to the jack. The top is machined off and a guide bolted on. The standard is of five-inch steel pipe with a holder so designed that the pipe and cylinder plunger or piston rod are always in line and act as a pivot. Small wheels, similar to those used on hand trucks, are applied to



A Portable Jack for Transferring Driving Wheels

one side of the jack and a socket is provided for a removable handle by means of which the jack may be moved from place to place.

To transfer a pair of wheels from one track to another the jack is placed underneath the axle with the holder at the center and air from the shop line admitted into the cylinder at the bottom. This raises the plunger, thus lifting the wheels clear of the rails. They are then turned in the desired direction on the pivoted holder, the air pressure in the cylinder relieved, the wheels lowered to the floor, and the jack removed. The wheels may then be rolled to another track, the handle inserted in the socket and the jack moved in position to again raise and turn the wheels as may be desired.

BENDING STIRRUP BRAKE HANGERS IN A BULLDOZER

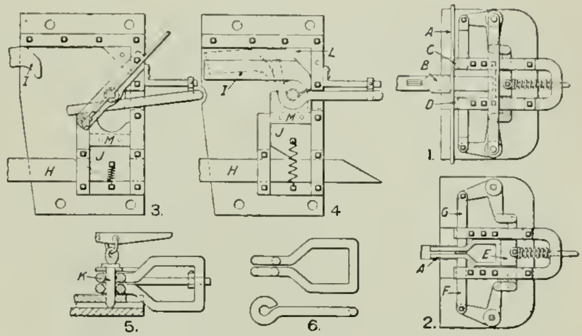
BY B. S. LYON

Blacksmith Foreman, C. B. & Q., Galesburg, Ill.

An attachment to a bulldozer for bending two eyes simultaneously has given very satisfactory results.

A piece *A* of 1-in. round stock of the required length is heated and placed in the position shown, Fig. 1, where *B*, advancing, binds *A* between *C* and *D*. As *B* continues to advance, the piece comes in contact with *E*, the movement of which compresses the spring and by the movement of two bell cranks operating *F* and *G* bends *A* as shown in Fig. 2. This completes the first operation.

The partly formed brake hanger is now reheated and inserted in a form for bending the eyes, as shown in Fig. 3. The two plungers, *H* and *I*, advance simultaneously, *H* pushing *J* and *M* forward, bending *A* as shown by dotted lines in Fig. 4. *I* then engages *A* and bends it around the pin *K* with a lateral motion imparted by *L*. This forms the eyes and completes the hanger as shown in Fig. 6. Fig. 5 shows the method of withdrawing the pin *K* from the eyes by the use of a lever and clevis.



The Attachment In Place on the Bulldozer

The two pieces *L* and *M* are removable so that other parts may be bent by substituting forms of the desired shape in place of those shown in the drawing.

ESSENTIAL FACTORS IN PROMOTING SHOP OUTPUT

BY GEORGE W. ARMSTRONG

The past eight months have witnessed a radical change in the operation of many large railroad shops through the elimination of piece work. However drastic the transition may seem to many, it should not present an insurmountable barrier to retaining a high degree of shop efficiency and in some instances of improving the quality of the output. The essential factors for the most successful shop operation, as stated by the writer in a previous article,* are not inherently different for the day-work system than for the piece-work system. The stressing of latent or neglected factors is, however, required adequately to meet the changed conditions. A brief exposition of some of these essential factors was embodied in the recommendations of a committee which recently investigated shop record and management conditions in the Eastern Region.†

First and foremost, the results attained are dependent upon the supervision, the existing degree of co-operation, attentive interest and responsiveness; in other words, an effective organization. Without co-operation and harmonious efforts of supervision and working force, the efforts of the best organization conceivable are nullified.

By sheer force and driving work may be put through a shop, but unless good feeling exists between the helper, mechanic, foreman, and shop superintendent the maximum output can never be attained. Harmony is the oil that overcomes friction—and yet harmony must not be secured at the expense of discipline, or abandoning the shop to the men in order to avoid possible labor complications. Firmness tempered with justice must be the prevailing sentiment.

The one question of justice has been the rock upon which many an organization has split. What is your idea of justice? What is the workman's idea of justice? How close does yours coincide with his? Do you make any effort to conform your ideas of management, discipline, etc., to the workman's views? Too often the actuating motive of organized labor effort has been the rankling idea that the workman was not receiving justice. Why not obviate possibility of distrust and implications of injustice by according labor a reasonable voice in local management?

Industry embodies two factors, capital and labor. Capital

*See the *Railway Mechanical Engineer* for June, 1918, page 341.
†See the *Railway Mechanical Engineer* for May, 1919, page 263.

has its representation in the business in expression through its directorate, staff officers and local supervision. Labor is restricted to its voice in collective bargaining.

Is it too much to accord labor a limited voice in the consideration of local management? Why not organize a workmen's shop committee as a portion of the shop superintendent's cabinet? The shop committee keeps the local supervisory head apprised of individual or collective grievances. But a shop committee dominated by the head of the shop is no good either to the working personnel or the employer. The manifestation of a sincere desire to insure justice, it is not unreasonable to suppose, may meet with a like response.

Unquestionably, for effective results, most shops have exhibited a dearth of supervision. The Eastern Regional committee's recommendation of one supervisor to 30 men is a maximum limit, especially for erecting or boiler shop work.

A shop scheduling system is absolutely necessary to secure expedited and co-ordinated movement of parts requiring replacement or repairs and prompt overhauling of equipment. Aside from its wholesome effect in this respect, it is an excellent indicator of the essential degree of co-operation existing in the organization and will do much to bring the laggard into line. Scheduling and routing material relieves the individual foreman of chasing material, thus affording greater opportunity for effective supervision of work.

The Eastern Regional committee report says:

"Experience shows that any system of despatching or scheduling of work through the shop must be predicated upon (1) a predetermined route; (2) a predetermined time."

The predetermined route or path over which the locomotive parts must travel is a fixed element depending upon the relation of various shop departments, sources of raw material storage, and location of machine tools within department bounds. While fixed, many improvements are not necessarily precluded. As far as possible changes should be made which will insure (1) straight line movement, and (2) balanced material trucking. Inasmuch as fixed routes which do not embody these requirements can exert a very retarding effect on scheduling, every effort should be made to study the routing thoroughly and effect all possible improvements before finally establishing a scheduling system.

Scheduling of necessity implies a despatching or scheduling supervisor. It requires a knowledge as to repair demands and a time limit. Knowledge of repair demands to be effective of the greatest good should not be confined to inspection upon arrival at the shop but supplemented by thorough advance information as to repairs required. Especially important is the knowledge as to whether new cylinders, wheel centers, driving boxes, fire boxes, extensive boiler repairs or heavy machine details are required. Properly used this information will enable the shop to prepare a greater portion of this material, or at least insure its availability in stock, so that when the engine is finally received it will involve removing defective portions and replacing these with new parts, while repairs are being made to minor details of construction, thus involving a minimum of idle time for repairs.

A predetermined time limit, to be a stimulus for bettered shop operation should be an attainable one, but yet one not reached without diligent effort. Nothing will be more detrimental to the successful use of a scheduling system than a repeated failure to meet the schedule.

In establishing suitable forms for a scheduling system too much detail is to be avoided, but essential information should not be sacrificed to secure brevity or conciseness. While it may be true that forms or reports never effect results, it is also true that the absence of proper reports permits the formation of many unguarded loop-holes and delays occur which are difficult of discovery. Forms convey standards, standards measure results and failures to secure results indicate points for investigation. How long would the business man dodge the sheriff if he did not keep a set of books? His books consolidate and provide control of the details of his business and the results lie in the details.

Scheduling requires inspection as the preliminary basis. Why not, then, enlarge the scope of inspection? A chief inspector reporting to the shop superintendent, with one or more assistants as may be necessary, can become one of the most powerful factors possible in insuring of quality workmanship. Such an inspection force can become thoroughly familiar with the standard maintenance practices, improvements ordered, etc., being charged solely with inspection duties. The subordinate supervision is thus relieved of these matters, leaving them free to devote themselves to departmental output, executive direction and discipline.

Unusual removals of material in stripping an engine should require the authorization of the inspection force and the decision as to repair or renewal of parts should be delegated to it. Miscellaneous small material could be inspected near the lye vat before delivery to respective departments for repair. If possible, material needed for replacement or repairs should be delivered with the dismantled material to the department overhauling it.

Material handling offers one of the greatest opportunities for improvement. Common labor is scarce, expensive and in the main always more or less inefficient. Mechanical facilities should be employed to the fullest extent. While in a good many shops overhead cranes assist in handling material from machine to machine or department to department, still considerable hand trucking is necessary. A reduction could be effected not only in cost of handling, but in size of force required by providing floors and walks smooth enough to operate electric trucks, preferably those embodying an elevating feature so that work is delivered to machine on a portable platform, removed from it to the machine, replaced by the machine operator and requiring simply to be lifted by the motor truck and readily transported to any point in the shop.

Why not employ an automobile truck with wide-rimmed wheels, for intershop material handling, providing wide doors in shops and roundhouses through which this truck could be run with its load of material and unloaded directly in the shop? This would eliminate much secondary handling.

Another feature of the material question which should be investigated is the possibility of securing material from the storehouse for use at various points in the shop without the necessity of men leaving their work to go to the storehouse. This can be secured by reasonable anticipation of wants and the installation of a messenger system which can be developed in connection with motor truck operation.

Orders for material may be left at different points in the shop, collected hourly and material delivered by motor despatch to the place required. This would eliminate a large loss in connection with the average shop operation in waste through loafing to and from shop and storehouse.

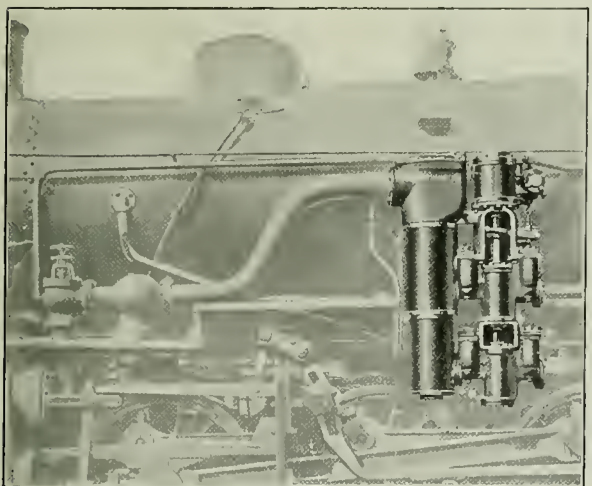
Miscellaneous small materials as bolts, nuts, washers, cotters, etc., could be placed in one or more accessible points in the shop and charged out in bulk through shop expense when delivered by the storehouse. This would reduce often needless delay and it is believed would be productive of ultimate economy in the use of materials.

An intercommunicating telephone, with a call system, placed through the shop so as to provide a phone every 100 or 150 feet would prove a large time saver and be productive of a great intangible economy. It could be effectively employed in conjunction with a material messenger delivery. Material could be ordered by the inspector or foreman, charged out by the storehouse office on a material blotter and delivered by the messenger. This would eliminate the written order and place the responsibility with the Stores Department for charging out material as well as delivery.

New Devices

AN OPEN TYPE LOCOMOTIVE FEED-WATER HEATER

The Worthington Pump & Machinery Corporation, New York, has developed and has in service on several Mikado type locomotives a combined feed pump and feedwater heater, which follows closely their marine practice. This heater is of the open type, which is now generally used in stationary power plants and is capable of handling 6,000 lb. of feed-water per hour. The full pressure of the exhaust steam is maintained in the heater, so that feedwater temperatures above 212 deg. F. are obtained when there is sufficient exhaust steam pressure available. It is designed for convenient attachment to the side of the locomotive boiler in a manner similar to that used for the attachment of air compressors.

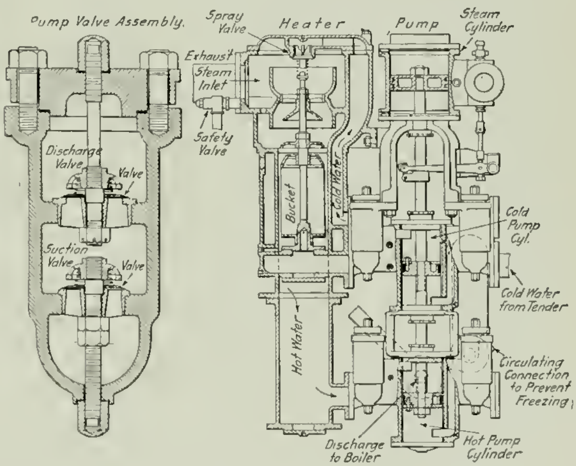


Pump and Heater Applied to Mikado Locomotive

The pump is of the vertical type with the steam cylinder at the top. It has two water cylinders, the upper or cold water cylinder taking cold water from the tender and delivering it to the heater, and the lower or hot water cylinder taking the heated water from the heater and delivering it to the boiler. The cold pump cylinder has a 6½-in. bore and the hot pump cylinder a 6 11/16-in. bore. Each of the pistons has four packing rings composed of ⅜-in. square (rock hard) piston packing. The drawing shows the pump valve assembly for both pump cylinders. The pump valves consist of three sheets of thin bronze, assembled with the smaller sheet on top and the largest on the valve seat. The valve seats, bolts, guards and springs are assembled before being placed in the pump. The suction valve seats are assembled with the long valve bolt projecting through the bottom of the pump chamber when the valves are in position. These valve seats make their joint on the pump chamber casting on the flat and not on the taper. The suction valves are held to their seat by the cap nuts on the lower end of the valve bolt, which are drawn up tight against two thin copper gaskets. The discharge valve seats are larger than the suction valve seats and also make their joint on the flat.

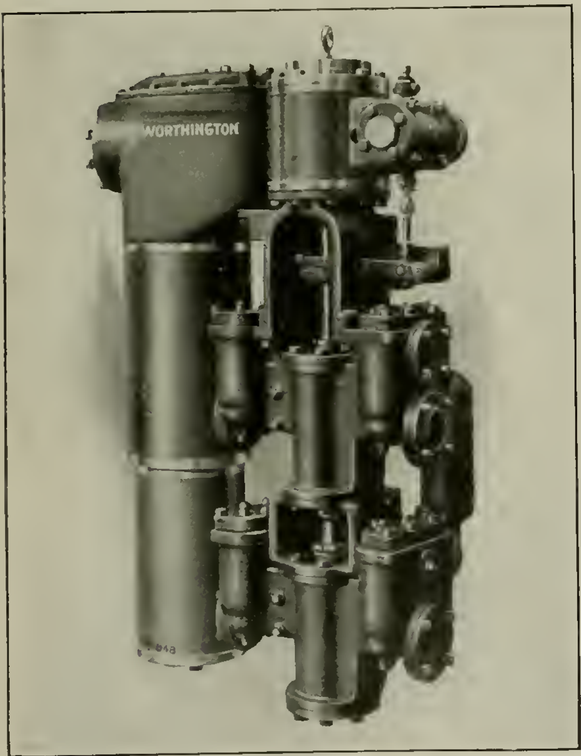
The heater is a cast iron box attached to the side of the pump by suitable pipe connections. The cold water, taken from the tender by the upper water cylinder, is delivered through a port in the side of the heater at the top, where it is sprayed into the upper part of the heater. Exhaust steam from the exhaust ports of the locomotive is led into this part of the heater through a six-inch opening in one side near the top. The cold water sprayed into this space condenses as much of this exhaust steam as is required to heat the water, and mixed with the condensate, drops to the bottom of the heater, where it is taken by the lower cylinder of the pump and delivered to the boiler. A ½-in. air vent is provided to prevent the accumulation in the heater of the air carried into it by the cold water and by the exhaust steam. A pipe from this air vent is led to a point where the air can conveniently be discharged between the rails.

The varying amount of exhaust steam condensed in heating the water necessitates some means of regulating the water level in the heater, and this is accomplished by proportioning the pistons of the two pump cylinders so that there will be a tendency for a slight excess of water to accumulate in the heater. This excess of water will return to the upper pump cylinder where it mixes with the cold water from the tender passing through that cylinder, and is again delivered to the heater. The water level in the heater is regulated by a bucket which is free to move vertically on the central stem, and having holes in its top through which it is flooded when there is too much water in the heater, causing it to sink. In sinking it uncovers holes in the central stem on which it slides, permit-



Section of the Heater and Pump Valve Assembly ting this excess of water to pass through a port to one of the suction valves of the cold water pump cylinder, from which it is returned to the heater with the water that is being taken from the tender. When the water level in the heater falls the bucket is partly emptied and rises, thus covering these holes and causing the cold pump cylinder to take all its water from the tender. The height of water in the boiler is regulated by the feed pump throttle, which consists of a 1¼-in. globe valve located in the cab. The valve connections between the heater and the locomotive are shown in the illustrations.

Exhaust steam is taken from the locomotive cylinders through holes cut in the back of the cylinder saddle casting and led through an angle stop check valve, thence through an oil separator having a continuous drip for the oil and water, and from this through the curved pipe to the top of the heater. The pump is driven by steam supplied through a pipe, which has a throttle valve conveniently located in the



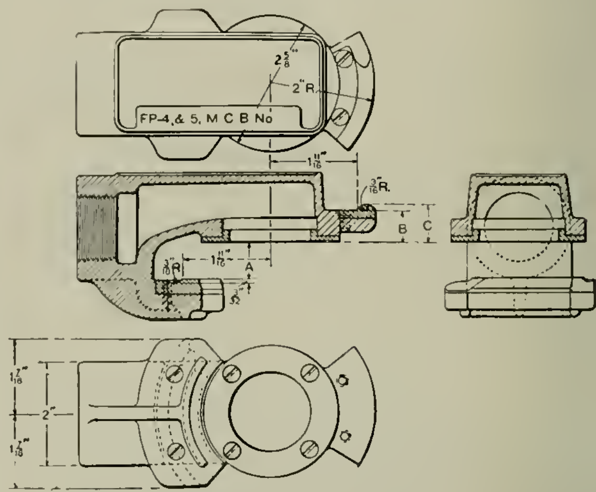
The Feed Pump and Heater

cab so that the pump can be operated at such speeds as conditions may require. The exhaust steam from the pump is led into the stop check valve, passes through the oil separator and thence to the heater with the exhaust steam from the locomotive. The pipe which conducts the cold water from the tender is shown passing behind the air compressor and entering the side of the upper or cold water pump cylinder. The heated feedwater leaves the lower or hot water pump cylinder by an opening in the rear and passes through a feed line to the boiler check valve.

So far as practicable the feed pump should be run continuously while the locomotive is in operation with the throttle open, but as the heater cannot recover any heat when there is no exhaust steam coming to it from the locomotive cylinders the injectors should be used when the locomotive throttle is not open.

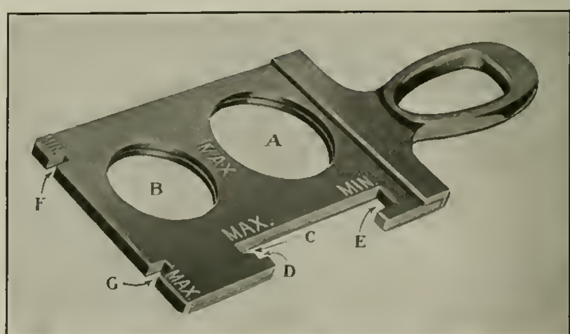
M. C. B. STANDARD HOSE COUPLING AND PACKING RING GAGES

The illustrations below show two gages adopted by the Mechanical Section of the American Railroad Association as recommended practice and now manufactured by the Westinghouse Air Brake Company, Wilmerding, Pa. The purpose of the hose coupling gage is to establish the amount of variation permissible in the guard arms of air brake hose couplings, which have become distorted or bent out of their normal position; and to determine whether the couplings are satisfactory for further use and interchange. The gages are



Gage for Testing Hose Couplings

intended for testing used couplings. Two gages are required for a set and, in practice, a coupling should enter gage No. 1 but should not enter gage No. 2. Couplings should be condemned when the guard arm is bent inward or outward from normal position; when bent inward the coupling will not enter gage No. 1 and when bent outward it will enter gage No. 2. The coupling may be used again by restoring the



Hose Coupling Packing Ring Gage

guard arm to its normal position. The Westinghouse Air Brake Company furnishes gages of the form shown for the standard FP-4 and FP-5 couplings.

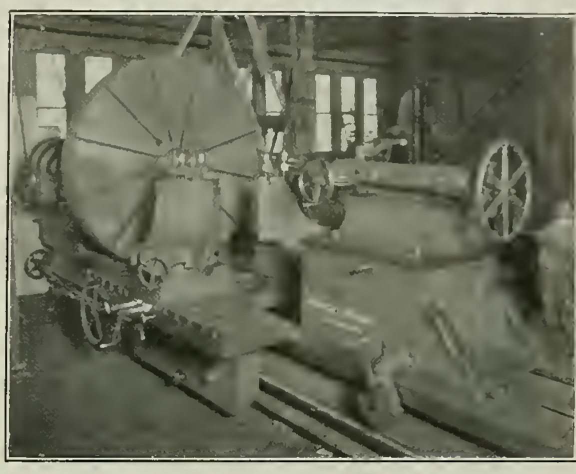
Variations in the dimensions of hose coupling packing rings are a prolific source of air brake leakage. In order to overcome this condition the Master Car Builders' Association has adopted as recommended practice a limit gage shown on sheet Q1 of the 1917 Proceedings. This gage provides a means for properly checking the maximum and minimum variations permissible in the dimensions of hose coupling packing rings, and further establishes a recognized standard for this item over the physical test specification. Opening *A* is for gaging the maximum and minimum external diameter of the packing ring flange. Opening *B* is for gaging the maximum and minimum external diameter of the projecting wall or face portion of the ring. Slots *C*, *D* and *E* are for gaging the height of the ring and the contour of the flange. Slots *F* and *G* are for gaging the maximum and minimum thickness of the projecting wall or face portion of the ring. Rings must enter all sections of the gage marked, *Max*, and must not enter any section of the gage marked *Min*.

A 96-IN. ENGINE LATHE

One of the largest lathes in the world, a 96-in. swing, triple geared Fifield engine lathe, has been produced by the Wright Works, Chicago. The machine is cone driven with the cone mounted on a back-shaft, this being necessary to obtain sufficient power to take the heavy cuts which would be required of a machine of this size. An eight-inch belt from a countershaft running at 200 r.p.m. transmits 40 hp. to the spindle of the lathe. The spindle is made of cast iron, on the theory that cast iron is less elastic than steel, and therefore will not spring when making heavy cuts, and for this reason reduces chattering. To compensate for the strength of a steel spindle the cast iron spindle is of generous proportions, the front bearing being 16 in. in diameter by 24 in. long, and the rear bearing 14 in. in diameter by 20 in. long.

The lathe is triple back geared and all changes in speed are obtained by moving the handwheel which is conveniently placed in front of the cone pulley within easy reach of the operator. The handwheel is geared to a lever shaft which materially reduces the effort required to shift the back gears into their desired positions. Only one change is made through sliding gears, the others being made by means of massive tooth clutches. The gearing and cone pulley is designed so that all speeds are in geometrical progression, the slowest speed being 0.75 r.p.m. and the fastest speed 76 r.p.m. Twelve speeds are obtainable through the four-step cone pulley and triple gearing with a ratio of 1.52 between each speed.

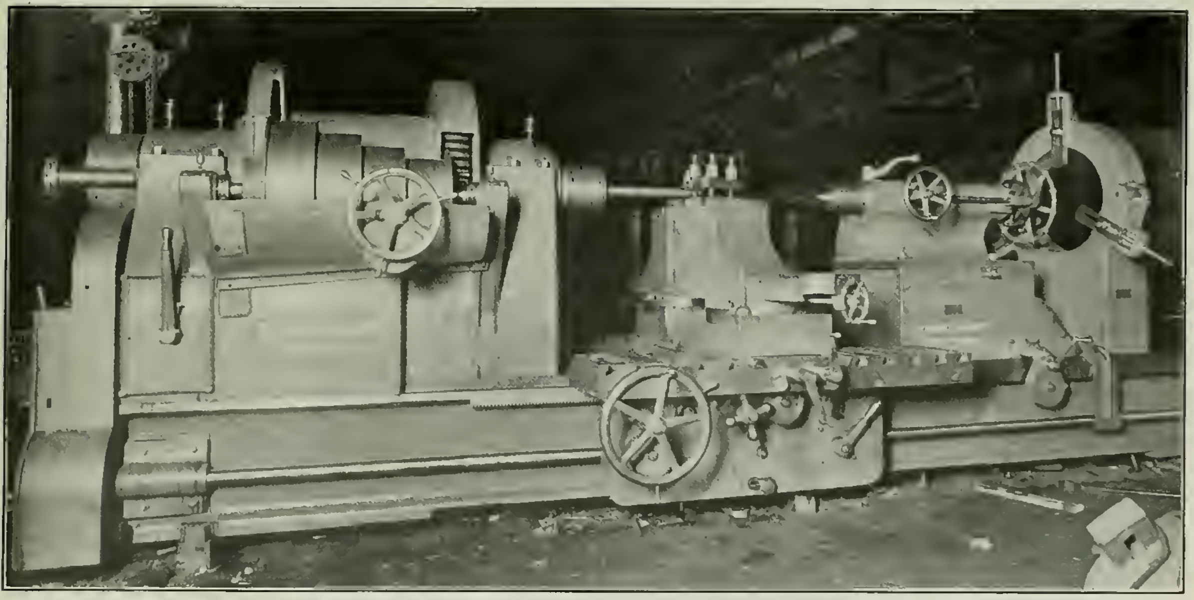
All of the gearing in the headstock, as well as throughout the machine, is made of steel and the pitch and width of face of the gears increase in proportion to the load which the teeth are required to withstand in turning the faceplate at the slow speeds required for work of large diameter. The triple gear which engages the faceplate internal gear has a diametral pitch of one and a face width of six inches.



Front View Showing the Massive Face Plate

Every shaft in the headstock runs in phosphor bronze bearings and is well lubricated by means of sight feed oilers which are in view of the operator at all times.

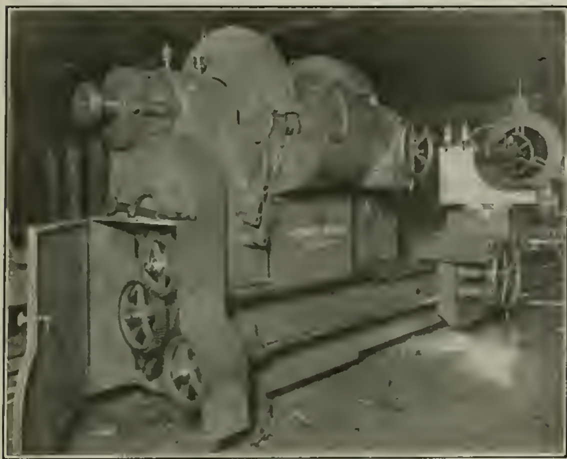
The feeds are also in geometrical progression and are obtained from a quick change gear box which is integral with the headstock. They are manipulated by the two levers shown in the illustrations, which move in either direction, giving four feeds of 0.025, 0.050, 0.100 and 0.200 in. for



The Lathe with the Face Plate Removed

each revolution of the face plate. More feeds may be had by changing the regular feed gears with the thread cutting gears. Twenty-four different threads may be cut by means of changing gears. All of the gears are guarded by covers or guards which are made conveniently removable where necessary while the gear change guard is provided with a door.

The carriage bears upon the ways for a length of 90 in.



End Showing the Change Gear

and is equipped with two compound cross slides which may be fitted with power angular feed if desired. The apron is fitted with steel gears and bronzed bushings throughout.

Buckling of the lead screw is prevented by means of supports which are adjustable and placed about 10 ft. apart.

The tailstock like the headstock is of box construction and is easily moved by hand by means of a geared device which engages the teeth in the rack on the bed. The tailstock spindle is moved by a handwheel which is placed convenient to the carriage. A massive steady rest is provided with each machine.

The bed is ribbed throughout with box sections and is fitted with a rack down a center rib which engages a pawl on the tailstock, thus removing the thrust of a cut from the clamps of the tailstock direct to the bed of the lathe. The total weight of the machine is 150,000 lb.

A LOCOMOTIVE PULVERIZED FUEL EQUIPMENT

A pulverized fuel equipment for locomotives has been developed by the Fuller Engineering Company, Allentown, Pa., and has been applied to a Lehigh Valley locomotive. This equipment consists of a fuel tank on the tender, the fuel feeding apparatus, a special arrangement of combustion chamber, slag or ash pans and smoke box. The device is mounted on the tender deck and is operated by a reciprocating steam engine and a steam turbine driven fan.

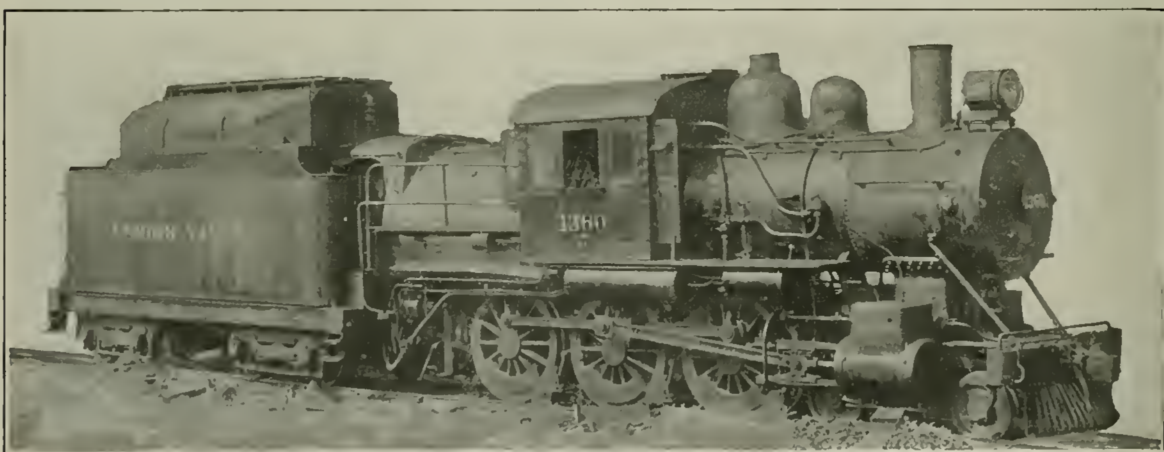
The standard brick arch supported on four 3½-in. arch tubes is applied in this locomotive as in hand fired practice, except that the arch is run within two feet of the back sheet and within about 12 in. of the crown sheet in the center, while the side bricks are not carried up so far.

The exhaust nozzles in this locomotive, of which there were two, were removed thus giving a free exhaust and eliminating all back pressure in the cylinders due to this cause. A sleeve has been secured to the end of the open exhaust stand and extended several inches up into the petticoat pipe. The petticoat pipe itself has been lowered 18 in. so that its lower end is now practically on a line with the center line of the boiler proper. This was done to reduce the draft in the front end, and thereby in the firebox, in order that the air and coal may enter the firebox at a velocity low enough to permit the coal to be completely consumed before being drawn over the arch, thus preventing the accumulation of slag on the flue sheet.

The pulverized coal tank is divided so that pulverized anthracite sludge may be carried in one side and bituminous coal in the other side. Very poor grades of coal can be burned in combination with soft coal by so manipulating the feed screws as to supply the proper proportions of soft coal and anthracite sludge necessary to maintain a proper temperature.

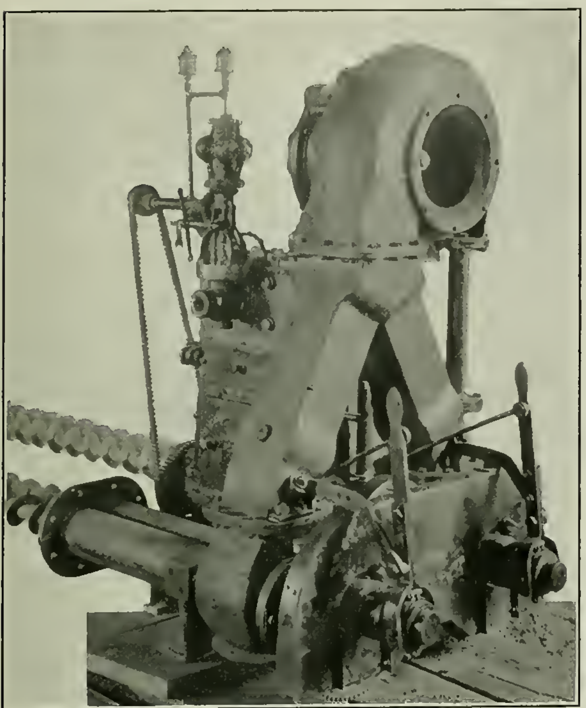
The apparatus for conveying coal from the tender to the locomotive consists of four 4-in. feed screws working in pairs and driven by a variable speed inclosed marine type two-cylinder double acting reciprocating engine. The fan for blowing the coal into the locomotive firebox is driven by a steam turbine. The turbine fan supplies approximately 15 to 20 per cent of the air required for combustion, the rest being drawn in by the action of the exhaust through the openings in the firebox and in the burner proper.

The four feeders operating in pairs prevent the fuel from arching over and feeding unevenly due to the tendency of



Lehigh Valley Locomotive Equipped with Pulverized Fuel Burning Apparatus the coal to become tightly packed in the tender by the constant vibration while the engine is running.

The reciprocating engine, which drives the feeders by means of a steel pinion and gears, is controlled by a wide range variable speed governor connected to the crank shaft by a Morse chain drive. A flexible shaft, controlling this governor, enables the fireman to obtain a variation of 346 per cent in the speed of the reciprocating engine, and thereby of the coal which is fed to the locomotive, without leaving his seat in the cab.



The Apparatus as Installed on the Tender

As it is carried forward from the tank the coal is pushed over two small shelves in the enlarged end of the feeding casing, where it is spilled off in two cascades, which are in turn caught between three currents of air from the turbine fan mounted directly above. This arrangement causes the coal to thoroughly mix with the air before it is blown to the burner, where it is further diffused and more air added to it.

The turbine fan is driven at constant speed while in operation, the determining factor being that the pressure through the hose and in the burner shall distribute the flame evenly beneath the arch without causing it to impinge on the flash wall and thereby cause undue deterioration of the fire brick.

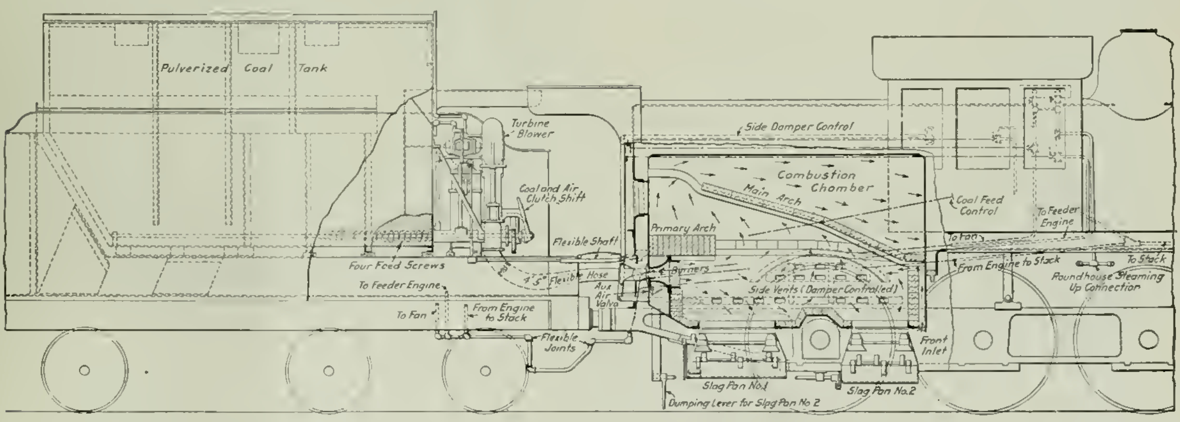
With the governor control and the two clutches a variation in coal feed of about 800 per cent between the minimum and maximum is obtainable with this apparatus, and the minimum can be reduced still further by throttling the steam in addition to the action of governor control.

Should either pair of the feeders become inoperative through some foreign matter being caught in them, the governor can be thrown out of operation and a single pair of screws can be driven at double the speed and thus supply sufficient fuel to operate the locomotive without failure. This wide range of speed is permissible as the ordinary maximum speed at which the reciprocating engine is run is less than half the speed of which it is capable, and this variation is also obtainable with the turbine fan without exceeding its rated capacity.

The maximum direct draft air pressure carried on the Fuller equipment is approximately three inches to four inches in the manifold beneath the fan or about 1¾ oz. to 2 oz., and this pressure is immediately reduced in the burner. A feature of the burner is that the flame spreads out and evenly fills the firebox beneath the arch no matter whether one pair or two pairs of feeders are in operation. The two pairs of feeders are thrown in or out as desired by the clutch shifters shown in the illustration and at the same time that either one of these is thrown out the air supply is also cut off from this side, thus preventing excess air from entering the burner.

A notable feature is that practically all of the air which enters the firebox, either through the burner or otherwise, is under the control of the fireman at all times, thus eliminating an excess of air and enabling the locomotive to be worked at maximum capacity without drawing in any more air than is necessary for complete combustion. At the same time this permits the velocity of the air entering the firebox through the different openings to be kept at a minimum. This is a desirable feature as it is chiefly the high velocity, accompanied by the abrasive action of the pulverized coal flame, and the high temperatures attendant thereto, which causes a rapid deterioration of the brick arch and the refractories in the firebox, while if these are properly controlled the life of the fire brick will be greatly prolonged.

To aid in preventing and controlling excessive and destructive temperatures a pyrometer is supplied with all pul-



Sectional View Showing the Application of the Pulverized Fuel Equipment verized fuel equipment furnished by the Fuller Engineering Company. The thermo-couple of this unit projects into the firebox beneath the brick arch about midway between the front and back sheets, and an indicating unit registering directly in deg. F., in plain view of the fireman, so that by manipulating the dampers and coal feeding mechanism the temperature can be kept at the desired point.

As this is a double cab engine with a Wootten type firebox dual control is provided so that the fireman can control the apparatus either from the tender deck or from his seat in the cab. A pyrometer indicating unit, a revolution counter showing the rate of coal feed and steam gages, indicating the pressure on the turbine fan and the boiler pressure, are located in the cab.

This apparatus as installed on the Lehigh Valley locomotive is designed to feed a maximum of approximately 4,600 lb. to 4,800 lb. of coal per hour, but this amount can be varied within considerable limits by simply changing the sprocket ratio between the governor and the feeder engine, or can still further be varied by changing the ratio between the pinion and gears driving the screws. This is a highly desirable feature as in this manner the same standard equipment can be used to feed a quantity of coal as low as 1,000 lb. or as high as 10,000 lb. an hour if desired, the only change necessary on the locomotive end being that different size burners and hose be employed for conducting the coal and air from the feeder to the burner.

The entire apparatus is assembled in one unit and can be secured to the pulverized coal tank with 18 bolts. It can be removed at any time without in any way disturbing the alinement of the gears, pinions, feed screws or any other part of the apparatus. As will be seen in the illustrations the whole apparatus is above the deck of the tender, where it is in plain view and easily accessible should any repairs or adjustments be necessary, and this feature also enables it to be applied to existing locomotives without cutting into the front water legs of the tender or without cutting below the tender deck to install it.

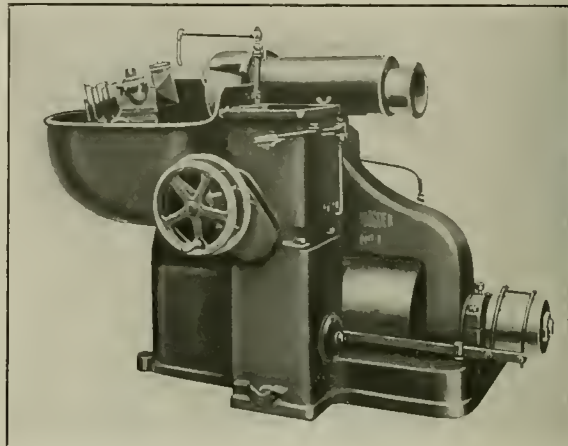
The apparatus as installed on the Lehigh Valley locomotive is said to have made a very creditable performance in a trip from the shops of the Fuller-Lehigh Company at Fullerton, Pa., to Atlantic City, during the recent convention of the mechanical section of the American Railroad Association, and also on its return trip to Fullerton.

THE LUMSDEN OSCILLATING TOOL GRINDER

A tool grinding machine designed to eliminate a large amount of tool forging and to increase production is being placed on the American market by Alfred Herbert, Ltd., 54 Dey street, New York. This is a British concern who developed this grinding machine during the recent war and are now introducing it in American shops. This machine is entirely self contained and may be driven by belt direct from the line shaft or motor.

Curved Top Face Tools

The grinding wheel is mounted on an inverted pendulum frame resting in large trunnion bearings in the base of the machine and oscillated by power. A variable eccentric motion controlled by a single lever or handwheel regulates the amount of oscillation. This eccentric arrangement is coupled to the swinging frame by a connecting rod adjustably connected to the frame by a swiveling joint. This adjustable connecting rod is controlled by a large handwheel on the front of the gear box and provides means of bringing the grinding wheel into correct relation to the tool. The grinding wheel is also adjustable in the operating frame the adjustment being controlled by another handwheel on the gear box. This provides for the feed of the grinding wheel to and from the work. By means of these two handwheels, easily reached by the operator, the grinding wheel may be moved sidewise and towards or away from the work without stopping the oscillating movement.



Front View Lumsden Grinder No. 1

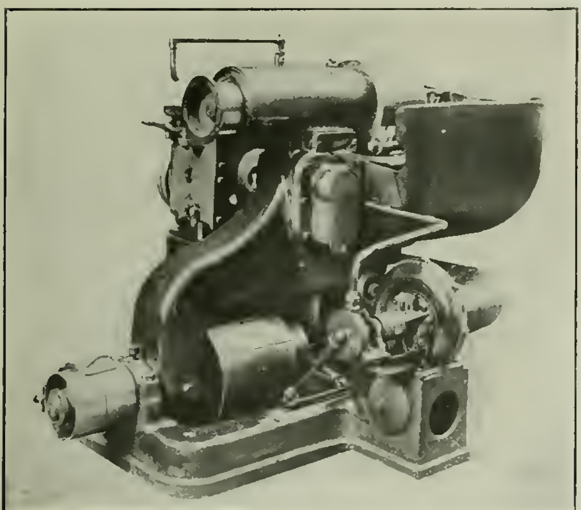
Tool Holder and Grinding Wheel

The lever controlling the oscillation is also located close to the operator's hand and the pedal for starting and stopping the machine is conveniently placed. This permits the operator to control the machine while standing in the best position to view the work being done.

The tool holder is universally adjustable for all tools other than those cranked to a right angle. A fixture for holding the latter and also for holding tools while being ground on the base is the only loose part used. The tool to be shaped is gripped in a simple chuck, which can be rotated through a complete circle on its own axis. The barrel which contains the chuck is carried in two trunnion bearings, so that the tool can be swung through an arc of about 10 degrees up or down. The trunnions have endwise adjustment in their bearings for use when grinding radius tools in which the center of the radius does not coincide with the center of the spindle. The whole tool holder can rotate on a vertical axis, enabling any side or the end of the tool to be presented to the wheel at any pre-determined angle. The tool holder is adjustable sideways on both sides of the center to allow the round nose of offset tools to be brought over the center of the vertical swinging movement.

The swivelling movement of the turntable on its vertical axis is extremely useful for grinding radius and round-nosed tools. To do this the tool is set so that the center of the desired radius is exactly over the axis of the turntable; then with the wheel stationary or oscillating but slightly the turntable is rotated back and forth until the desired curve merges into the sides and end of the tool.

Any shape or form of tool can be ground quickly without the use of a former, template or fixture other than the one specified, with the exception of tools which have a concave top face. Such tools may be ground by means of the curved face attachment, which is supplied for use on all Lumsden oscillating tool grinders. It consists of a swivelling tool holder fitted to a lever-operated slide and is arranged to fit in the tool holder of the machine. In using this device, the profile of a number of tools—the shape seen from the top—is first ground without the use of the attachment. They are then finished with curved top faces by means of the curved face attachment furnished with each machine in very little more time than would be required if they were ground with flat top faces. The degree of curvature given to the tool can be varied by commencing the grinding nearer to or farther from the cutting edge.



Rear View Showing Dust Exhauster Fan and Pump

Duplicate tools can be shaped very rapidly by making use of the adjustable stops provided for each movement of the tool holder. Each movement also has its own secure clamping arrangements, holding the tool rigid while being ground.

The grinding of new tools is done without the use of water, but when resharpening hardened tools water is necessary and the grinders are fitted with a pump and a tank for supplying water when required.

A powerful fan connected to a duct in the base of the tool holder draws all dust and chips away from the work and the operator and provision must be made when installing these machines to carry this away from the delivery pot of the fan.

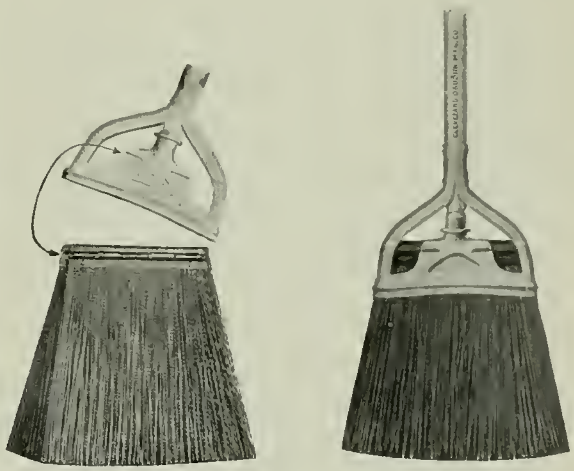
With this machine only a small amount of rough forging is required for any tool within the range of the grinder and many tools may be ground from pieces of straight bar without any forging work except to bend the end of the tool when the desired shape requires it to be done.

THE EDLUND DETACHABLE BROOM HEAD

A broom having a detachable head and known as the "Edlund" is being manufactured by the Cleveland-Osborne Manufacturing Company, Cleveland, Ohio. The broom consists of a metal holder with a clamping device and a detachable filler or broom.

The holder and clamping device is of pressed sheet steel secured to a wooden handle and is arranged with a rectangular socket, into which the filler or broom is inserted and secured by the clamp. The device is constructed so that the filler can be inserted in the holder by slipping a ring off the broom clamp and so placing the filler that the bead on the filler fits into a groove in the holder. The ring is then pushed over the clamp, thus securing the broom firmly in place.

These brooms are made of bass, bassine or bahia fibre and are furnished in grades suitable for the service in which they are to be used. They have given most satisfactory and economical service in factories, railway shops and storehouses, and tests have shown that the Edlund broom will outwear from four to six of the ordinary corn brooms. These brooms can be worn to a very short length because of the manner in which the fibres are bound together and the percentage of waste is very low. The holder is so constructed that with ordinary use it will last indefinitely and it is only necessary to purchase additional fillers, which, because of their simple construction and durable material, reduce the broom cost to a minimum.



The Edlund Broom

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WE GUARANTEE, that of this issue 10,600 copies were printed; that of these 10,600 copies 9,582 were mailed to regular paid subscribers, 20 were provided for counter and news company sales, 210 were mailed to advertisers, 28 were mailed to employees and correspondents, and 610 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 73,210, an average of 9,151 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

During the month of June 169 locomotives were built, 12 in company shops, 45 by the builders on orders prior to federal control and 112 U. S. R. A. standard locomotives.

The shops of the New York, New Haven & Hartford at Valley Falls, R. I., were destroyed by fire on the night of July 26; estimated loss $130,000. The fire was started by lightning.

It is reported from Petrograd that the number of discarded Russian locomotives which can no longer be used amounts to nearly 60 per cent of the total stock. About one-fourth of the railway carriages are in the same state.

The National Screw Thread Commission sailed for Brest from Hoboken, N. J., on July 13, to meet French engineers in Paris and then proceed to London, for the purpose of making a tentative agreement on pipe thread standards with the British Engineering Standards Association.

The Pennsylvania System federation of employees, composed of six crafts employed in the shops of the railroad, held their first annual convention at Columbus, Ohio, on July 14. The federation represents more than 40,000 men employed in various shops of the Pennsylvania System.

It is reported that the Texas & Pacific Railroad will have more than 200 of its engines equipped for using oil as fuel in a short time, for service on the entire line between New Orleans and El Paso. The Texas & Pacific has had a few oil burning locomotives in use for several years.

Locomotives which were pooled to meet the exigencies of war conditions have now been practically all returned to the roads on which they were originally operated. All are said to have been repaired and placed in good condition before being returned. The total number under lease to various roads was about 800.

The Pennsylvania Lines West of Pittsburgh will build a group of repair shops at Stark, Ohio, to consist of a locomotive erecting shop, heavy and light machine shops, tank shop, flue shop, wheel and pipe shop, blacksmith shop, firing up shed, storehouse, office building, rest house and shed for the storage of miscellaneous material.

According to an Associated Press despatch the work of recovering stolen Belgian machinery from Germany is proceeding with full swing. Approximately 3,000 tons of machinery are being shipped back weekly to the original owners by German industrial firms, who had set them up in their own factories. The total tonnage returned to July 1 was 18,000.

It has been demonstrated that it is possible to make pig iron and iron castings direct from steel scrap in an electric furnace, and it is claimed that such iron, cast in the form of castings, is far superior to the same castings made from ordinary pig iron melted and cast. Tests recently made at Columbia University show its tensile strength to be 40,730 to 45,030 lb. per sq. in., considerably higher than of ordinary cast iron.

The shops of the Pullman Company at Ludlow, Ky., recently destroyed by fire, will probably not be rebuilt, according to a letter from Director General Hines to the Chamber of Commerce. The letter states that the shops were obsolete and that their usefulness was limited. Mr. Hines also asserts that many of the men formerly employed in the Ludlow shops have secured other positions and therefore were not greatly discommoded by the nonexistence of the plant.

Three hundred shop employees of the Southern Railways at Alexandria, Va., went out on strike on June 17 by way of protest against what they term the delay in passing on the proposed uniform rules and working conditions and also the general demand of the shop employees for an advance in wages which have both been before the Board of Wages and Working Conditions for some time. The strike was unauthorized and the men returned to work later in the day.

Enginemen on the Southern Railroad went on strike because they were required to run large new engines of the Santa Fe type through the numerous tunnels between Danville, Ky., and Oakdale, Tenn. With these engines the clearance at the sides and top is so small that the flow of fresh air is seriously checked; so much so that in hot weather the enginemen have reported temperatures in cabs of 140 deg. F. Fans to ventilate the cabs, by air drawn from below the pilot, are being fitted to the engines.

Losses of gasoline during transit are estimated by one prominent producer and shipper of gasoline to amount to eight per cent, considering only that shipped in tank cars. During 1918, about 3,500,000,000 gallons of gasoline were produced in the United States and much of it was shipped more than once. A loss of one per cent, at 20 cents a gallon, means a loss to the shippers and to the nation of $7,000,000. The railroad loss and damage figures recently published, are large, but the shippers' probable wastage through leakage and evaporation during transit is larger.

Railroad Administration reports show that 101,785 women were employed in railroad service in September, 1918, while in April, 1919, there was a reduction of 14.3 per cent, or a total still employed of 85,393. This was partly due to the general reduction in the labor forces and also to the return of the soldiers from army service. The largest percentage of decrease was from among the clerical force. In the mechanical section the largest number of reductions among the women employees took place in the roundhouses and shops. Their work in these departments was in many cases found to be unsatisfactory, the work being generally considered too heavy.

Representatives of the coal operators, as part of their propaganda to induce the early buying of coal, are already complaining of an impending car shortage and are urging the Railroad Administration to take more active steps to put cars in repair. The directors of the National Coal Association in resolutions recently adopted, declare serious car shortages exist, and that there is an abnormally large number of cars out of service awaiting repairs. George H. Cushing, managing director of the American Wholesale Coal Association, testified at Washington on July 18 before a House committee that there are many idle coal cars in all parts of the country which should be repaired.

The *Monthly Labor Review,* published by the United States Department of Labor, contains an article on the employment of women in acetylene welding, in which it is stated that they have demonstrated that they are better suited to the lightest sorts of welding than men. In England short welding courses were instituted early in the war with decided success and welding courses in many of the technical schools are now open to women. English women have done all types of welding with marked success, but in the United States they have not been given as many or as difficult types of work. It is the consensus of opinion that they have been most successful in the lighter grades of work, such as are centered in the airplane manufacturing around Detroit and it is agreed that work from which very heavy lifting cannot be eliminated is unsuitable for them. The estimates of welding authorities place the number of women welders in this country at from 1,000 to 1,500 or more, but very few of these are sufficiently skilled to do general high class welding repair work.

Bureau of Standards Studying Paint Standards

The Bureau of Standards of the United States Department of Commerce is engaged in a study of paint and paint materials in connection with a committee of scientific representatives of the government departments, including the Railroad Administration, with a view of making acceptable standard specifications to be promulgated by the bureau for the information of the public which, when issued, it is stated, will make available to the railroads a fund of information regarding paint which they have not had heretofore. Percy H. Walker of the Bureau of Standards is chairman.

Railroad Men Wanted in Russia

A request has been received at the office of the chief of engineers, War Department, Washington, from the Russian Railway Service Corps for additional men to serve on Russian railroads. At the present time there is need for first class accountants, store and material men, stenographers, shop superintendents, trainmasters, traveling engineers, round-house foremen, car foremen and foundry superintendents. These men will not be in the United States Army, but will wear a uniform and be members of the Russian Railway Service Corps, a separate service formed for the specific purpose of handling railway matters in Russia. Accountants and store material men will receive from $2,000 to $2,500 a year, shop superintendents approximately $5,000 a year, trainmasters and traveling engineers $2,500, roundhouse foremen and car foremen $2,000, and foundry superintendents $3,000. Col. L. M. Wright, Director General of Military Railways, Office of Chief of Engineers, Washington, D. C., is handling inquiries concerning the service.

Machine Tool Builders Withdraw Opposition to Government Sales Abroad

As the result of an explanation by Secretary of War Newton D. Baker of sales and machine tools abroad by the United States army, Cincinnati machine tool builders are said to have withdrawn their objections to such sales. The State Department inquired of the War Department for information regarding the sale of machine tools in Belgium and France and Secretary Baker's reply is in part as follows:

"The policy of this department is to dispose of surplus material both at home and abroad as rapidly as possible and with as little disturbance of the trade as is practical under the circumstances.

"In the United States each bureau is, thus far, making its own sales through its district offices under the policy set forth by the director of sales. A representative of the director of sales has been negotiating the sales abroad.

"Sales to date in this country have totaled $3,200,411.10 for machinery, machine tools and engineering equipment which cost the government $3,898,833.85. We have therefore disposed of this material for 82 per cent of the cost to the government, which, I think you will agree, is a very creditable showing and does not indicate any disposition on the part of the War Department to disturb the home market.

"The sale which is being negotiated with the Belgians by our representatives abroad is for slightly used machines in good condition on the basis of August 1, 1914, prices, plus 55 per cent c.i.f. Antwerp.

"The average advance reported by 133 manufacturers of this line from 1914 to 1918 was approximately 93 per cent. Since the armistice the average drop on new machinery has been about 20 per cent.

"One of the largest houses reconditioning used machinery states that in normal times their sales of entirely made-over machinery average around 75 per cent of new. For this machinery, sold as it stands, you will readily see that we are not offering it at improperly low prices, as stated by your correspondent, but at very fair prices which ought not materially disturb the trade for new machinery."

MEETINGS AND CONVENTIONS

Traveling Engineers Association.—The annual meeting of the Traveling Engineers' Association, to be held at Hotel Sherman in Chicago in September, will begin on the 16th instead of the 9th; and will hold through Tuesday, Wednesday, Thursday and Friday, ending on the 19th.

International Railway General Foremen's Association.—General car foremen are invited to attend the convention of the International Railway General Foremen's Association, which will be held at the Hotel Sherman, Chicago, on September 2 to 5, inclusive. One of the topics under discussion will be draft gears.

Master Car and Locomotive Painters' Association.—The forty-eighth annual convention of the Master Car and Locomotive Painters' Association will be held at the Hotel La-Salle, Chicago, commencing September 9. The association has held no meetings during the past two years, and the program for this year's convention is practically the same as that selected for 1917. The following papers will be presented: The Advantage of Using Pure Paints and More Time in the Painting of Steel Equipment, by Warner Bailey (B. & M.); What Quality and Size of Sand Pebble Are the Best for Blasting Paint or Corrosion From Steel or Iron, Preparatory to Painting, by J. W. Gibbons (A. T. & S. F.), S. E. Breese (N. Y. C.) and George M. Oates (Pressed Steel Car Company); The Record of Our Association, by Charles E. Copp (B. & M.); What Standardization of Painting Railway Equipment Is Necessary, Based Upon the Experience of This Association? by W. A. Buchanan (D. L. & W.), H. M. Butts (N. Y. C.) and W. O. Quest (P. & L. E.); Is the Demand for Linseed Oil as a Paint-Making Oil in Excess of the Supply; If So, What Other Oils Are Most Acceptable Substitutes for the Railway Paint Shop? by A. H. F. Phillips (N. Y. O. & W.), P. J. Hoffman (Hocking Valley) and F. B. Davenport (Penn. Lines).

Master Blacksmiths' Association.—The International Railroad Master Blacksmiths' Association has announced the following papers which are to be presented at the convention to be held at the Hotel Sherman, Chicago, August 19-21: Repairs to Locomotive Frames, P. Lavender (N. & W.), chairman; Drop Forging and Its Possibilities, J. D. Boyle (Anderson Drop Forge Company), chairman; Heat Treatment of Iron and Steel, Purposes and Results, G. Hutton (N. Y. C.), chairman; Why Railroads Should Adopt Specific Standard Safety Appliances to Comply with U. S. Standards, J. E. Dugan (U. P.), chairman; Making and Repairing Springs, John W. Russell (Pa.), chairman; Up-to-Date Smith Shop, G. Fraser (A. T. & S. F.), chairman; Scrap Reclaiming by use of the Oxy-acetylene and Electric Cutting and Welding Process and Other Methods, Walter Constance (St. L. & S. F.), chairman; The Treatment and Results of Carbon, High Speed and Other Alloy Tool and Tool Steels for Tools, J. H. DeArment (Pa.), chairman; A Modern Hammer and Hydraulic Forge Shop, R. F. Scott (P. & R.), chairman. The officers of the association are: President, W. C. Scofield (I. C.); chairman executive committee, W. J. Mayer (M. C.); first vice-president, J. Carruthers (D. M. & N.); second vice-president, G. P. White (M. K. & T.); secretary, A. L. Woodworth (B. & O.); assistant secretary, C. W. Shafer (C. of Ga.).

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Association, Section III—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago. Convention, August 27-29, Hotel Sherman, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—H. J. Smith, D. L. & W., Scranton, Pa.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio. Convention Aug. 19-21, Hotel Sherman, Chicago.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention September 2-5, 1919. Hotel Sherman, Chicago.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention, September 9, Hotel La Salle, Chicago.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Convention, September 16-19, Hotel Sherman, Chicago.

PERSONAL MENTION

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

J. B. Carothers, assistant to the federal manager of the Baltimore & Ohio, Western Lines, with headquarters at Cincinnati, Ohio, has had his jurisdiction extended over the departments of fuel and locomotive operation.

H. P. Dougherty has been appointed assistant director of the Division of Labor, United States Railroad Administration.

C. I. Evans, whose appointment as chief assistant mechanical superintendent of the Missouri, Kansas & Texas and associated railroads, with office at Denison, Texas, was announced in these columns last month, was born in Bedford, Iowa, and was educated in the high schools. Before entering the service of the Missouri, Kansas & Texas he had been for six years employed as a fireman and engineman on other roads. He has been with the Missouri, Kansas & Texas for 25 years, having started as a locomotive engineman, later being promoted to road foreman of engines. Subsequently he served as trainmaster, then as lubricating expert, and at the time of his recent appointment he was chief fuel supervisor. In his present position he has direct charge of shops and all matters connected with the maintenance of locomotives and cars and reports to the general manager.

D. R. MacBain, whose appointment as assistant general manager of the New York Central, Lines West, with headquarters at Cleveland, Ohio, was announced in these columns last month, was born on October 23, 1865, at Queenstown Heights, Ont., and was educated in the common schools. He entered railway service in October, 1876, as a machinist apprentice on the Canadian Southern, and was later locomotive fireman and then locomotive engineman on the same road. From 1890 to July, 1900, he was a traveling engineer on the Michigan Central, and then until June 23, 1906, was master mechanic, latterly at Jackson, Mich.

D. R. Mac Bain

On the latter date he was appointed assistant superintendent motive power at Detroit, Mich. From April 1, 1908, to May, 1910, he was assistant superintendent of motive power of the New York Central & Hudson River at Albany, N. Y. On May 15, 1910, he was appointed superintendent motive power of the Lake Shore & Michigan Southern, the Lake Erie & Western, the Lake Erie, Alliance & Wheeling, the Dunkirk, Allegheny Valley & Pittsburgh, the Cleveland Short Line, the Chicago, Indiana & Southern and the Indiana Harbor Belt. Later he was appointed superintendent of motive power of the New York Central Lines West, with headquarters at Cleveland, Ohio, which position he held until he was recently appointed assistant general manager of the same lines.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

F. D. Barnes, road foreman of engines of the Central of Georgia, with headquarters at Macon, Ga., has been appointed trainmaster of the Macon division, with headquarters at Macon, succeeding H. R. Frierson.

L. E. Fletcher, master mechanic of the Atchison, Topeka & Santa Fee at Raton, N. M., has been transferred to the Arkansas River and Colorado divisions, with headquarters at La Junta, Colo., succeeding I. H. Drake, assigned to other duties.

Frank Lafond has been appointed road foreman of engines of the Los Angeles division of the Southern Pacific (lines south of Ashland), with headquarters at Los Angeles, Cal., succeeding R. N. Richardson, assigned to other duties.

T. T. Ryan, general foreman of the Atchison, Topeka & Santa Fe at Las Vegas, N. M., has been appointed master mechanic of the New Mexico division, with headquarters at Raton, N. M., succeeding L. E. Fletcher.

CAR DEPARTMENT

M. C. Devine has resumed his duties as general car foreman of the Missouri, Kansas & Texas at Sedalia, Mo., having been engaged in government inspection work in Hammond, Ind.

SHOP AND ENGINEHOUSE

J. Skelton has been appointed day roundhouse foreman of the Denison (Texas) locomotive shops of the Missouri, Kansas & Texas, succeeding J. T. Smith, who is now night foreman.

PURCHASING AND STOREKEEPING

T. S. Edgell has been appointed division storekeeper of the Mobile & Ohio at Murphysboro, Ill., succeeding E. H. Landers, resigned to accept service with another company.

R. R. Jackson has been appointed division storekeeper of the Pittsburgh division of the Baltimore & Ohio, Eastern Lines, with headquarters at Glenwood, Pa., succeeding T. C. Hopkins, assigned to other duties.

H. P. McQuilkin, assistant general storekeeper of the Baltimore & Ohio, Eastern Lines, has been appointed general storekeeper of the Baltimore & Ohio, the Cumberland Valley, the Western Maryland and the Cumberland & Pennsylvania, with headquarters at Baltimore, Md. Mr. McQuilkin was born on February 6, 1887, at Martinsburg, W. Va., and was educated in the public and high schools of his native town. He began railway work on April 1, 1905, as distributor in the stores department of the Baltimore & Ohio at Cumberland, Md., and the following year served as clerk in the motive power department. He was out of railway work from October, 1906, to September, 1910, and then became storekeeper on the Baltimore & Ohio, at Connellsville, Pa. He was later storekeeper at Washington, Ind., and from April, 1914, to December, 1916, was district storekeeper for the Baltimore & Ohio and the Cincinnati, Hamilton & Dayton at Cincinnati. He was then, to April, 1918, chief clerk to the general storekeeper on the Baltimore & Ohio at Baltimore, and subsequently served consecutively as chief clerk to the purchasing agent until June, 1918, and assistant general storekeeper, until his promotion to general storekeeper on the same road.

P. H. Shay has been appointed storekeeper of the Lehigh Valley, with headquarters at Caxton, Pa.

Gordon Thomas has been appointed storekeeper of the Lehigh Valley, with headquarters at Hazleton, Pa.

R. E. Walker has been appointed storekeeper of the Lehigh Valley, with headquarters at Auburn, N. Y.

OBITUARY

Joshua A. Leach, founder of the Brotherhood of Locomotive Firemen & Enginemen, died on June 27, at Denver, Colo., where he was attending the organization's triennial convention. Mr. Leach organized the Brotherhood of Locomotive Firemen & Enginemen at Port Jervis, N. Y., in 1873. He was 76 years old.

Oscar Otto, general superintendent of the South Philadelphia Machine Works of the Westinghouse Electric & Manufacturing Company, died on June 30, as a result of injuries received in an automobile accident near Westgrove, Pa. He was born in Manitowoc, Wis., on January 2, 1859, and after finishing his apprenticeship course as a machinist in the Manitowoc shops of the Chicago & North Western, served during several years at various places in Wisconsin. He then entered the service of the Northern Pacific, at Tacoma, Wash., going from there to the Oregon Short Line, at Salt Lake City, Utah. In 1898 he returned to the service of the Chicago & North Western as superintendent at the Chicago shops. Prior to accepting a position as general superintendent of the Westinghouse Machine Works, at East Pittsburgh, Pa., in June, 1909, he was connected with the Chicago & North Western as general superintendent of its Chicago shops. When the Westinghouse Company opened its new plant at Essington, Pa., Mr. Otto supervised the installation of the machinery, and later in February, 1918, he was transferred to the new works, where he remained until his death.

Matthew J. McCarthy, superintendent of maintenance of equipment of the Baltimore & Ohio, Lines West, with headquarters at Cincinnati, Ohio, died at his home in that city on July 12. He was born at Susquehanna, Pa., in 1868, and began railway work in 1889 as an apprentice on the Erie, and subsequently worked in a number of railroad shops in the west and southwest as machinist and foreman. He was for ten years in the service of the Chicago, Burlington & Quincy, at Burlington, Iowa, as machinist inspector and general foreman, then was with the Michigan Central, as division master mechanic at St. Thomas, Ont., for four years, and during the next two years served as division master mechanic on the Lake Shore & Michigan Southern. Mr. McCarthy then went to the Cleveland, Cincinnati, Chicago & St. Louis, as superintendent of shops at Beech Grove, Ind., and later was assistant superintendent of motive power at Indianapolis, on the same road. In January, 1913, he was appointed superintendent of motive power of the Baltimore & Ohio Southwestern and the Cincinnati, Hamilton & Dayton, at Cincinnati, Ohio, later his title was changed to superintendent of maintenance of equipment of the Baltimore & Ohio, Lines West.

M. J. McCarthy

SUPPLY TRADE NOTES

The Edison Storage Battery Company announces the removal of its district office in Pittsburgh, Pa., to room 431 Union Arcade building.

The Camden Forge Company, Camden, N. J., has opened a district sales office at 2 Rector street, New York, with Samuel W. Hilt as manager.

J. E. Slimp has been appointed general manager of the Unit Railway Car Company, Boston, Mass., manufacturers of interurban and short line railway cars.

Harold E. Wade has been appointed president of the Fairmont Gas Engine & Railway Motor Car Company, Fairmont, Minn., succeeding Frank E. Wade, deceased.

The Walter A. Zelnicker Supply Company, St. Louis, Mo., has added 2,000 sq. ft. to its present office space at 325 Locust street, St. Louis, an increase of 33 1/3 per cent.

The Chicago Pneumatic Tool Company, Chicago, has removed its Minneapolis (Minn.) office from the Metropolitan Bank building to Fifth avenue and Fifth street south.

H. A. Wolcott has been appointed district manager of the Ohio Locomotive Crane Company, Bucyrus, Ohio, for the Chicago territory, with office in the Lytton building, Chicago.

E. H. Roelofs, assistant engineer of motive power on the Philadelphia & Reading, with headquarters at Reading, Pa., has resigned to enter the service of the Baldwin Locomotive Works.

J. L. Dahl has been appointed manager of the New York office of the Gregg Company, Ltd., Hackensack, N. J. He succeeded C. R. Gier, who is no longer in the employ of the company.

D. C. Schultz, Sr., who has had a wide experience in the design and sale of Morgan & Northern cranes, has been appointed sales manager of the Pittsburgh Crane & Equipment Co., with headquarters at Sharpsburg, Pa.

Frank O. Leitzell, assistant to the general manager of the H. K. Porter Company, Pittsburgh, Pa., has been appointed an engineer-salesman in the sheet and tin mill specialties department of the Blaw-Knox Company, Pittsburgh, Pa.

John McConnell, who had charge of alloy steel production for the Interstate Iron & Steel Company, Chicago, as assistant to the vice-president with headquarters at Canton, Ohio, has been promoted to vice-president with headquarters at Chicago.

Major John L. Wood, formerly connected with the Buckeye Steel Castings Company, Chicago, and interested in several railway supply companies, including Edwin S. Woods & Co., Chicago, died on June 13 at Pasadena, Cal., after a protracted illness.

Robert S. Hammond, formerly sales agent of the American Steel Foundries, Chicago, has been appointed Pittsburgh (Pa.) representative of the Whiting Foundry Equipment Company, Harvey, Ill., with office in the Fulton building, succeeding F. J. Page.

The Ulster Iron Works, Dover, N. J., has completed a new puddling mill at Dover, with the main building 390 ft. by 77 ft. and an adjoining wing 90 ft. by 60 ft. Eleven double puddling furnaces are now being operated and 11 additional furnaces of the same type will be installed. The entire output of the mill is distributed by Joseph T. Ryerson & Son, Chicago.

The Liberty Car Wheel Company, Hammond, Ind., has been incorporated with $500,000 capital stock and the following officers have been elected: President, Patrick H. Joyce; vice-president, F. O. Bunnell; treasurer, John E. Fitzgerald; secretary, Charles Aaron.

Lieut.-Col. Elmer K. Hiles, Engineers, A. E. F., who went over as captain in the Fifteenth Engineers, has returned after nearly two years' service in France, and has joined the Pittsburgh Testing Laboratory as manager of laboratories, with headquarters at Pittsburgh.

Elliot Reid, assistant to general manager of the Westinghouse Lamp Company, 165 Broadway, New York, has been appointed sales manager, and will have charge of the commercial activities of the company in both large and miniature classes of lamps in domestic territory.

Arthur Osmore Norton, president of A. O. Norton, Inc., Boston, Mass., died while writing a letter, on June 8, in his home at Coaticook, Que. He was born on February 17, 1845, on a farm in Barnston township, about ten miles from Coaticook. The family moved to a farm in Coaticook when he was a small boy, and he began his business career as a clerk in the country store. When he was about 30 years old, he started a jewelry business in Coaticook, later doing a wholesale business, and subsequently was in the wholesale jewelry business in Boston under the firm name of Norton Brothers & Butters. In 1888, he started the manufacture of the Norton ball-bearing lifting jacks, produced in two factories, one in Boston and the other in Coaticook. Mr. Norton was the first to make non-fluid self-lowering jacks; he was also the pioneer in the making of ball-bearing screw jacks.

A. O. Norton

Corporal William A. Nugent, who served during the war in Company 1, 21st Engineers, has returned from France, and resumed his duties with the Independent Pneumatic Tool Company, Chicago, as traveling representative. He has been assigned to his former territory in Indiana.

G. E. Scott, who for the past year and a half has been in the service of the American Red Cross at Washington, D. C., and from September, 1918, as general manager, has received his honorable discharge and resumed his duties as first vice-president of the American Steel Foundries, Chicago.

Albert Brunt, who for the past four years has been engineer in charge of the direct-current machine design section of the industrial engineering department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has resigned to return to Holland, his native country.

Samuel O. Dunn has been elected a vice-president of the Simmons-Boardman Publishing Company, publishers of the *Railway Mechanical Engineer* and other publications, including the *Railway Age*, of which Mr. Dunn is editor-in-chief. His headquarters continue to be in Chicago.

Arthur S. Lewis, formerly with the Chicago, Cleveland Car Roofing Company and more recently with Flint & Chester, New York, has become associated with the Barco Manufacturing Company, Chicago, and will for the present be located at New York City, and cover Southern territory.

J. H. Redhead has been appointed assistant to the vice-president in charge of miscellaneous sales of the National Malleable Castings Company, Cleveland, Ohio. C. C. Gibbs, until recently associated with the sales department of the Indianapolis plant, has been appointed sales agent of the Cleveland plant, succeeding Mr. Redhead.

W. H. Woody, until April 17, 1919, supervisor of the shipfitters and allied trades at the government navy yard, Portsmouth, Va., and before enlistment in government work affiliated with the Chicago Pneumatic Tool Company, Chicago, as special representative, has been placed in charge of the Washington, D. C., office of the Keller Pneumatic Tool Company, Chicago.

F. P. Hoeck, superintendent of materials and stores of the International Railways of Central America, writes that the material department and commissary stores of his railroad requires new catalogues to replace those destroyed during the recent earthquake. Those desiring to furnish such catalogues are requested to send them to the purchasing department of the International Railways of Central America, 17 Battery place, New York, for enclosure.

Theodore L. Dodd & Company, 80 East Jackson boulevard, Chicago, have been appointed western sales representatives for the Worth Steel Company of Claymont, Del., manufacturers of high grade steel for railroad uses in connection with fireboxes and boilers. This company has a 160-in. mill with four 100-ton open hearth furnaces. It was formed by former members of the Worth Brothers Company of Coatesville, Pa., which concern was sold to the Midvale Steel Company several years ago.

George C. Isbester, district sales manager of the Rail Joint Company, with headquarters at Chicago, has resigned to become district sales manager of welded and weldless products for the American Chain Company, Inc., with headquarters at Chicago. Mr. Isbester was connected with the mechanical department of the Great Northern Railway at St. Paul, Minn., from 1897 to 1899, leaving the Great Northern at this time to go to the Sargent Steel Company, with headquarters at Chicago. He remained with this company until about 1902, when he went with the Q & C Company, with headquarters at Chicago, afterwards becoming vice-president of that company. In 1912 he left the Q & C Company to go with the Rail Joint Company as district sales manager, which position he held until his change as noted above. Mr. Isbester has been a director of the National Railway Applicances Association for several years until his resignation recently. During the war Mr. Isbester served in the United States Naval Reserve Forces as Lieutenant Commander, having been on active duty from April, 1917, until he was placed on the inactive list during May, 1919. He was recalled to active duty on July 28, 1919, to be sworn in as commander in the supply corps. He was selected for promotion from lieutenant commander to commander by the Board of Selection, and after receiving his promotion he was again detached from active duty. Commander Isbester has also served with the Illinois Naval Militia for ten years.


G. C. Isbester

The Chicago Pneumatic Tool Company announces the following changes: H. B. Barbee has been appointed manager of eastern railroad sales and Nelson B. Gatch district manager of sales, with headquarters at 52 Vanderbilt avenue, New York, to succeed L. C. Sprague, who is now manager of western railroad sales, with headquarters in Chicago. N. S. Thulin has been appointed a special railroad representative on Mr. Sprague's staff. T. J. Hudson, Jr., district manager at Chicago, is now manager of the pneumatic tool sales division.

Kenneth R. Hare has been appointed district manager for the Transportation Engineering Corporation, New York, with headquarters at Chicago, in charge of the territory in the middle west, including Chicago, St. Louis and other important railroad centers. Mr. Hare was graduated from the University of Wisconsin in 1911 with the degree of electrical engineer, having previously spent his vacations on railroad location and construction in Northern Minnesota, as concrete inspector and later in connection with transit and level work, estimates, etc. He also did considerable work in connection with the electrical construction, installation of dynamo electric machinery, transformers and switchboards for the Duluth Edison Company, and the General Electric Company. After graduation he took the test and shop course at the Schenectady works of the General Electric Company, following this, in 1912, with construction and meter work for the Great Northern Power Company, Duluth, Minn. Later, in the same year, he was appointed chief electrician for the Northern Pacific Railway, in charge of all electrical work from St. Paul to the Pacific Coast. In 1915 he was appointed associate editor, and later became managing editor of the Railway Electrical Engineer, published by the Simmons-Boardman Publishing Company, New York. He left this position in 1917 to enter military service as first lieutenant in the Ordnance Department. In 1918 he was appointed, on behalf of the government, assistant superintendent of the munition plant of the American Can Company, Kenilworth, N. J., in direct charge of the high explosive plant, remaining in that position until the work of the plant was about finished. He now becomes district manager of the Transportation Engineering Corporation, which is the authorized representative of the Edison Storage Battery Company in the sale of storage batteries to railroads, and of the Automatic Transportation Company in the sale of industrial trucks and tractors to railroads.


K. R. Hare

The American Steam Conveyor Corporation, Chicago, has established an office in the North American building, Philadelphia. H. S. Valentine has been appointed sales engineer in charge of the Philadelphia territory. He was formerly associated with the Link Belt Company, Philadelphia, for five and a half years, and with the Brown Hoisting Machinery Company and the Yale & Towne Manufacturing

Company for six years. Thomas O. Morgan, until recently head of the service department of the New York office of the company, has been promoted to the position of sales engineer and will cover Long Island and Connecticut territory.

The Q & C Company, with general offices at 90 West street, New York, announces the formation of The Q & C Packing & Lubricator Company, with general offices at the same address and a factory at 70 Pearl street, Jersey City, N. J. Charles F. Quincy is president of the new company; W. W. Hoit is vice-president, and F. F. Kister, treasurer, all of the present Q & C Company organization; S. S. Whitehurst, vice-president, and J. G. Smaltz, secretary, are now officials of Steele & Condict, Inc., Jersey City, N. J., where increased manufacturing facilities are being provided to care for the Q & C piston rod packing and lubricator.

Pratt & Lambert, Inc., Buffalo, N. Y., announces that its New York office at 185 Madison avenue, will be moved about November 1 to a new site in Long Island City, where a modern warehouse of brick construction, 200 ft. by 100 ft., consisting of two stories and basement, is now being built, not far from the Bridge Plaza. Donald L. Clement, former railway representative, who has recently returned from overseas service, will be assistant resident manager of the New York office. In order to increase the production at the main factory, Buffalo, a four-story brick building, 95 ft. by 45 ft., to be devoted to grinding, is to be put in service on October 1. At Bridgeburg, Ont., a four-story brick building, 85 ft. by 45 ft., is being erected in addition to new chimneys, double the size of the old, thinning buildings, filter buildings and other equipment which will triple the manufacturing capacity of the present factory.

Bertram Smith, assistant general sales manager of the Edison Storage Battery Company, Orange, N. J., has resigned to become president and general manager of the Automatic Electrical Devices Company, Cincinnati, Ohio. Mr. Smith has had more than 20 years' experience in the storage battery industry. He formerly served as secretary and treasurer of the old National Battery Company, which sold the Sperry plate, and after the absorption of this company by the United States Light & Heating Company, he was for a number of years manager of the western territory, with headquarters at Chicago. In 1913 he resigned to become assistant manager of the Edison Storage Battery Supply Company, with headquarters at San Francisco, and in 1915 was appointed manager of the Detroit sales district for the Edison Storage Battery Company. In September, 1918, Mr. Smith was made assistant general sales manager of that company, with headquarters at Orange.

The Norton Grinding Company and the Norton Company, both of Worcester, Mass., have been consolidated under the latter name. George I. Alden, who has been president of the Norton Company for some years, is chairman of the board of directors of the reorganized company; Charles L. Allen is president and general manager, Aldus C. Higgins, treasurer and general counsel and George N. Jeppson, secretary and works manager. Two new vice-presidencies have been created, one to be filled by W. LaCoste Neilson, vice-president and foreign manager, and the other by Carl F. Dietz, vice-president and general sales manager. A factory for the manufacture of abrasive products has been established in Japan and the company has acquired control of the Hiroshima Grinding Wheel Company, located at Hiroshima, near Kobe, Japan, which was established some years ago by the company's agents. Sales agencies have been established with native houses in several foreign countries, including England, France, Italy, Belgium, Denmark, Holland and like connections will be formed in Norway and Sweden. A new store at Detroit, Mich., has also been opened under the management of C. W. Jinnette.

CATALOGUES

Ventilators.—A six-page folder has been issued by the Garland Ventilator Company, Chicago, briefly describing and illustrating by means of drawings some of the best known and most widely used types of Garland railway car ventilators.

Electric Traveling Cranes.—A new catalogue of Chesapeake cranes has been compiled by the Chesapeake Iron Works, Baltimore, Md. The book contains 28 pages, 9 in. by 11½ in. The first half is devoted to descriptions and illustrations of the various parts of the cranes, while the last half contains full page illustrations of installations.

Curtain Roller.—The Curtain Supply Company, New York, is revising its catalogue, which will hereafter be issued in the form of bulletins describing and illustrating their various products. The first of these, R-2, covers the Rex all-metal curtain roller and consists of eight pages, describing the construction of the roller and illustrating the detail parts.

Flange Lubrication.—A flange oiler which is simple in construction, having two working parts, said to be easily applied, to eliminate slipping and to require no attention, is being placed on the market by J. H. Miner of Lumberton, Miss. This he describes in a booklet of eight pages.

Storage Battery Cars.—Typical installations of Edison equipped railway storage battery cars are shown in Bulletin 106, consisting of 16 pages and issued by the Edison Storage Battery Car Company, New York. Illustrations show cars in service in various parts of the United States, Central and South America, Mexico and Alaska. A short analysis is included of the relative costs of storage battery and steam operation on the Long Island Railroad and the Edison nickel-iron-alkaline storage battery is described.

Vulcan Soot Cleaner.—Bulletin 541, issued by the Vulcan Soot Cleaner Company, Du Bois, Pa., contains a discussion of the merits of the Vulcan patented diagonal method for cleaning soot from the tubes of horizontal water tube boilers, covering such features as maintenance cost and first cost, accessibility for inspection and repairs and ease of installation and cleaning. Illustrations in two colors show typical designs as applied to horizontal water tube boilers with vertical baffling. The bulletin also contains an analysis of the cost of Vulcan cleaners and their value as investments.

Whiting Railroad Equipment.—The Whiting Foundry Equipment Company, Harvey, Ill., has prepared Catalogue 145, containing 36 pages, to show the advantages and labor saving features of the various railroad specialties manufactured by this company. The equipment described in this catalogue consists of screw jack locomotive and coach hoists, transfer tables for locomotives and coaches, cranes and turntable tractors. For those contemplating new shops a drawing of a modern shop layout, showing the most practical and economical arrangement of the equipment, is included.

Hydraulic Machinery.—A catalogue of 63 pages, embracing all kinds of hydraulic machinery, has been prepared by William H. Wood, hydraulic engineer, Media, Pa. These machines include flanging, riveting, punching and shearing machines, cranes, hammers, valves, pumps, accumulators, etc. Several drawings are also shown of the Wood's flexible corrugated locomotive firebox and a summary of the results of comparative tests, made some years ago on the New York Central, of a Wood's firebox with arch tubes and a standard firebox without arch tubes.

Railway Mechanical Engineer

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CONTENTS

The Labor Turn-Over

A discussion of the labor turn-over problem, which is of more than ordinary interest, will be found on another page of this number. It is not written by either an efficiency engineer, an expert employment officer, or an executive. There is nothing theoretical about it. The writer who had had considerable experience as a mechanic on a railroad, had gone into industrial work and then returned again to the railroad shop. His viewpoint is that of a mechanic. We hope that all of those foremen and other officers who control shop conditions will read it closely. Doubtless your shop is much better equipped than the one in which "Newt" had his experience. Fortunately, most railroads long ago awakened to the necessity for improving these conditions. On the other hand, even the best equipped shops may fall far short of the ideal in many respects. Good work cannot be done with a dull or inefficient tool. To get the best results from the workmen, conditions must be such as to emphasize the fact that the management is interested in their comfort and convenience, and is willing to do its full share in helping to make the conditions most favorable for good work.

The Valve Setter

There is no portion of the work incident to turning a locomotive out of shop that is of greater importance than the proper setting of the valves. A locomotive may have correctly proportioned grate area and draft appliances and be otherwise in first-class condition, yet will not give economical service if the valves are not so adjusted as to secure the maximum value of the steam supplied to the cylinders. The loss of efficiency, even with the increased fuel consumption that always occurs with poorly set valves, is of such proportions that the utmost care should be taken in doing this work. The valve setter, through incompetence or indifference, can destroy the possibility of securing the benefits that should be derived from a well designed and carefully constructed machine. Observations taken on a number of locomotives known to have improperly adjusted valves have shown an increase of from 15 to 20 per cent in fuel consumption. At the same time these locomotives have decreased in efficiency from 9 to 15 per cent. The setting of valves should be conducted with the utmost care and the instructions of the designers closely followed. The men doing this work should be selected not only for their general intelligence, but should be of the type who are exacting as to detail, as this is a matter of minute adjustment and a very slight deviation in setting the valve will cause wasteful results in the operation of the locomotive.

A Bright Spot in the Industrial World

Against the background of industrial unrest, suspicion and strife with which the conduct of the economic processes of the nation and the world is being beset, the resolutions adopted by the representatives of some 30,000 employees of the Midvale Steel & Ordnance Company, the Cambria Steel Company and their subsidiaries, in session at Atlantic City on August 22 and 23, stand out in strong relief. The opinion of these employees, expressed in the resolutions, is that "the persistent and unceasing demands of workingmen employed in all classes and kinds of industries for a shorter day's work and an increased rate in order to meet the present high cost of living is uneconomic and unwise and should not be encouraged." That these men have a keen appreciation of the real situation is evident from the reasons given for this opinion, namely, that "the price of commodities is regulated by the day's labor of a man and the real unit of value or the unit of compensation is not a dollar, but the purchasing power of a dollar, and that the average price of commodities varies with the average compensation received for an hour's work by every man and every woman," and that the only sure remedy for the high cost of living is increased production and stabilization of prices in conformity with wages now being paid. It is significant that the employees of the Midvale and Cambria Companies are organized under one of the so-called industrial democracy plans to which reference has previously been made in these columns. While these resolutions are hardly sufficient evidence on which to claim the complete success of such plans, they are indicative of the sane attitude which may be expected from any group of workers when their relations with the employer are organized on a basis of open dealings and mutual freedom from suspicion.

Front End Inspection

The careful inspection of front ends of locomotives bears a very close and important relation to fuel consumption and should be given constant attention in roundhouse work. A frequent source of trouble and a serious cause of loss in steaming efficiency is leakage around the tubes in the front sheet. This was clearly demonstrated in the case of a locomotive selected for a series of tests of front-end arrangements. After a few trial trips with repeated failure of the locomotive to steam properly, even with the most careful firing by the best fireman on the division, an inspection of the front tube sheet disclosed numerous leaks, notwithstanding that a supposedly competent man had inspected the locomotive before the tests were begun. After these leaks were stopped a conservative estimate placed the saving in coal burned at approximately 1,000 lb. per hundred miles. At the price of fuel prevailing, this effected a considerable economy in fuel cost, as well as adding greatly to the efficiency, and consequently the earning power, of the locomotive. Other apparently trivial matters, such as poorly made joints between the exhaust stand and nozzle were found to have a very appreciable effect on the performance of the locomotive. The need of economy in these times of high prices of fuel and the necessity that the earning power of equipment be kept at the highest possible point warrant the most exacting inspection whenever possible between the regular inspection periods. This can readily be accomplished in the roundhouse, provided the men are each instructed that it is not only their job to make repairs as directed by their foremen, but also to report any defect that may come to their notice. Consistent co-operation of the mechanics and inspectors in the roundhouse will insure worth while results.

Car Department Problems

Changes in the application of the M. C. B. rules of interchange which take effect October 1, are such as to put the rules almost on a pre-war basis. The task of reorganizing the car department's forces and practices will not be an easy one, particularly in view of the changes in the personnel of the forces which have taken place during the past year or two.

The meeting of the Chief Interchange Car Inspectors & Car Foremen's Association at St. Louis, September 23-25, promises to be largely attended, and will, of course, be of more than ordinary interest because of these changing conditions. Like the Traveling Engineers' Association, the members of this organization concern themselves with an important and very highly specialized work. They are in daily touch with the practical application of the rules of interchange and with the detail problems of car operation and maintenance. Because of the radical changes which have taken place in the car department under wartime conditions, this organization or some other must also give early and thorough attention to the problem of recruiting the car department forces and of improving supervision in such a way as to insure that the workmen will be fully coached and educated as to how best to do their work.

The condition of the freight car equipment generally is very bad. During the war, material and labor conditions made it necessary to repair the cars only to such an extent as to keep them in service for the time being. The result of this policy, which, of course, was necessary, is now beginning to be felt, and the situation promises shortly to become acute. It demands immediate attention in a big way. Some car department officers are of the opinion that it will be necessary to have the deferred work done in outside repair shops. Others feel that with determination and support from above, the car department forces can be organized to do the work. Necessarily it will require heavy expenditures both for labor and material. When we consider what a breakdown in railroad operation may mean at this time in restricting national production and in preventing an earlier return to normal conditions, it would seem that those in authority would not long hesitate in taking the necessary steps to remedy this condition, no matter how high the cost may be.

The Traveling Engineers

Special importance attaches to the annual meeting of the Traveling Engineers' Association which will be held in Chicago, September 16-19. This organization has consistently confined its energies to the problem of improving locomotive operation, and from a purely practical standpoint alone has accomplished really remarkable results. Now it is faced with the question of deciding its future relationship to the American Railroad Association and particularly to Section III—Mechanical thereof. It is of vital importance—and this is not an exaggerated expression—in the interests of increased efficiency of operation for the railroads at large, that the action which is taken be such as to encourage and further intensify the good work which has been done so well by the Traveling Engineers' Association.

Efficient and economical locomotive operation is one of the keynotes to greater efficiency of railroad operation. The members of the Traveling Engineers' Association are largely men who are on the actual "firing line" on the road; a fact which is readily apparent to anyone who has attended the meetings of the association. These men know what they are talking about because of intimate contact with operating conditions. Because of this and because the nature of their work is such as to force them to express themselves clearly and concisely, and because they are educators and leaders in locomotive operation, their composite opinions and conclusions, as reached in conference, must carry real force and special weight.

Next in importance to deciding wisely upon the necessary changes in organization is the advisability of taking steps to insure making the personality and efforts of the traveling engineer, or whatever his title may be, more effective. It is, unfortunately, only too true on many roads that these men are handicapped and burdened with detail duties that largely prevent their being on the road as much as is desirable, or indeed necessary, for the best interests of the railroad. Men who are fitted by experience, ability and personality to educate and influence the enginemen to secure better results are being forced to give entirely too much of their time to clerical and other duties which could just as well be handled by men of less experience and not so well fitted for road work. They should not be required to assign power, despatch engines, keep up the force, assign crews and other work of this sort. Or if they are, then it should be clearly understood that they are not expected to do much road work, and steps should be taken to build up a special staff to do this work. No one will dispute the fact that it is necessary to have a competent staff on the road to supervise locomotive operation; the trouble lies in the fact that many roads are fooling themselves into the belief that they have such a staff, while, in reality, although the men are carrying titles which indicate that they are responsible for the road work, they are actually spending little or no time on the road. This situation should be remedied.

Heat Treatment of Locomotive Forgings

The heat treatment of locomotive forgings was regarded as an important advance in locomotive construction when first introduced, but at the present time the practice seems to have fallen into disuse on many roads where it has been tried. Nevertheless the Master Blacksmiths' Association at its recent convention advocated the use of heat treatment wherever possible.

The statement has been made that heat treated parts have proved unreliable in service, and certainly during the period when heat treating was first used there were many failures that for the time being remained unexplained. These troubles from heat treated material were probably due to the effort to secure extremely high tensile strength by qurnching at a high temperature and drawing at a low temperature, making the steel liable to fracture. Furthermore, some manufacturers attempted to meet the demand for heat treated material by doing the work with inadequate equipment and inexperienced men. Considerable progress in the heat treatment of large forgings has been made during the war, and at present the manufacturers can furnish a much better product than formerly.

The successful use of heat treatment on automobile forgings has been pointed out as demonstrating the feasibility of improving the properties of locomotive forgings by heat treatment. The fact must not be overlooked, however, that large pieces cannot be cooled as rapidly as small pieces, and in driving axles or similar parts there is certain to be a considerable difference in temperature between the interior and exterior of the forgings. Experiments have demonstrated that large forgings subjected to the same heat treatment as smaller pieces of the same chemical composition show a lower elastic limit and lower tensile strength, usually accompanied by a slight reduction in the elongation and reduction of area. This effect is particularly noticeable in alloy steel. For example, a test piece of nickel chrome steel in the form of a five-inch cube quenched and drawn, showed an elastic limit of 125,000 lb. per sq. in., tensile strength of 134,000 lb. per sq. in., with elongation and reduction of area of 18, and 58 per cent respectively. A forging from the same ingot 12 in. in diameter, treated at the same temperature, showed an elastic limit of 74,500 lb., or approximately 60 per cent of the elastic limit shown by the test piece. The tensile strength of the forging was 109,000 lb. per sq. in., the elongation 15 per cent and the reduction of area 42 per cent. This shows conclusively that it is unreasonable to expect the same properties in locomotive forgings that are secured in the smaller parts used for automobiles.

To call attention to the benefit to be derived from the use of heat treated material would be superfluous. Heat treated material has proved satisfactory in all respects except uniformity of results and concerted action by the railroads, co-operating with the manufacturers, should eliminate the difficulties which have prevented the railroads from using it more extensively. Where forgings are to be made by the railroads it might be well to pay more attention to the heat treatment of carbon steel, with which the railroads' blacksmiths are more familiar. On the other hand, alloy steel should not be neglected. If more importance were attached to securing a high elastic limit with moderate reduction of area and elongation, it would no doubt be possible to obtain steel which would show uniform properties and yet be very satisfactory for use for locomotive parts.

The Issue Before the Shop Crafts

President Wilson and Director General Hines cannot be too strongly commended for the unequivocal stand they have taken on the question of wage increases in denying increases ranging from 17 to 27 cents an hour to railway shop men. The labor situation, complicated by the question of the relationship of an increase to the shopmen to the rates of other classes of railway employees and by the apparent difficulty with which the national leaders of the shopmen's unions were maintaining a reasonable degree of discipline in the ranks of their organizations, has thereby been greatly clarified. The issue is now clearly drawn. Are the shopmen's unions to pursue a course of selfishness which will defeat their own ends or will they display an enlightened self-interest which does not overlook the rights of the public and the national welfare?

Vigorous action has been taken by the Administration to arrest the upward trend of prices and to reduce the cost of living and it is probable that nothing is being left undone to accomplish everything in this direction which can be accomplished by corrective legal measures and concerted action of the administrative forces of the government. At the outset, however, results must be slow in appearing and until time has demonstrated what measure of success may be expected from the experiment, the least that each citizen or group of citizens can do is carefully to refrain from injecting any new disturbing elements into the situation. A lack of steadiness on the part of any group of the public will seriously jeopardize all efforts to bring the cost of living under control.

The fundamentals of this situation have evidently been clearly visualized by some of the organized railroad men themselves. The efforts to reduce living costs now being made by the federal government were strongly advised both by Warren S. Stone, president of the Brotherhood of Locomotive Engineers, and W. G. Lee, president of the Brotherhood of Railway Trainmen, who stated frankly that this was the real remedy rather than further increases in wages.

What then will be the position of the shopmen's unions if they vote to strike in an effort to enforce their demands for a general wage increase? First, they will have caused a serious interruption of transportation and distribution of the necessities of life. An irreparable economic loss will result. Prices of necessities will increase and there will be general suffering, in which the shopmen will participate. Second, this loss and suffering will be brought about to enforce demands which, should they be granted, will ultimately result in adding $800,000,000 a year to the country's transportation bill, starting a new cycle of increased wages and increased production costs, leading straight toward national disaster

And this will all be undertaken in direct opposition to the program advised by the leaders of other organizations of railroad men and will undoubtedly meet with the condemnation of these great bodies of the shopmen's fellow-workers.

These facts have all been placed before the men and will be considered by them in making their decision. They have also been clearly presented to the public and whether it be assumed that the President's statement was an appeal to public opinion, or merely voiced public opinion, it is reasonably clear what attitude the public will now take should the shopmen strike. Under such conditions, accompanied by the same firmness and unequivocal stand in dealing with the strike as that shown in dealing with the demands for a general wage increase, the prospects for success are practically hopeless.

The issue is clearly drawn. Will the men aid the nation in obtaining economic stability, in the benefits of which they will themselves participate, retaining thereby the honor and respect of the public? Or will they attempt to bring on chaos, thereby making themselves the enemies of society, with loss of influence and dishonor to themselves and their organizations? The country awaits the answer.

COMMUNICATIONS

INADEQUATE MAIN DRIVING BOXES

BROOKLYN, N. Y.

TO THE EDITOR:

Mr. Murdock's communication on inadequate main di ving boxes which appeared in your issue of July, 1919, is inteiesting in that it draws attention to practices, at least a part of which have long been standard for long main boxes. His aversion to a constant spring thrust to maintain adjustment of wedges is not warranted or justified by the results obtained in service, as the automatic spring adjusted wedge has repeatedly demonstrated itself to be a most excellent device. It automatically takes care of expansion of the metals in driving boxes and maintains adjustment to compensate for wear of the faces of the shoe, wedge and box. That this is desirable with present box equipment there can be no doubt.

Mr. Murdock's reference to the taper of wedges is erroneous, the standard taper used by the American, Baldwin and Lima locomotive companies being one inch per foot. The angle of this taper is 4 deg., 47 min. According to good authorities, the angle of repose of smooth surfaces occasionally greased lies between 4 and 4½ deg. That is to say, the surfaces will slip at the angle mentioned. Therefore, somewhat more than sufficient spring thrust to sustain the weight of the wedge is necessary to take care of the piston thrust. In fact, the usual spring thrust, with the automatic wedge, varies between 1,600 lb. and 2,100 lb. The taper of the automatic wedge is 1 5/16 in. per foot.

When the pistons of a locomotive are moving in opposite directions, because the centers of the cylinders and the centers of the driving box bearings do not lie in the same transverse plane, the forces acting on the driving box bearings exceed the piston thrust in a ratio which is directly proportional to the ratio of the distances apart of these centers.

Assume that the distance between centers of driving boxes, in the four engines of the writer's tabulation, on page 174 of the April, 1919, issue is 42 in., and that the distance between the centers of the cylinders is 74 in. in the four coupled, 86 in. in the six coupled, 91 in. in the eight coupled and 95 in. in the ten coupled. The ratio, by which the piston thrust must be multiplied to obtain the pressure on the bearings of the main boxes is 74/42 in the four coupled, 86/42 in the six coupled, 91/42 in the eight coupled and 95/42 in the ten coupled.

Using the foregoing ratios and the piston thrusts given in the tabulation referred to above, lines 15 and 16 should read differently and a new line should be added as follows:

	Four-coupled	Six-coupled	Eight-coupled	Ten-coupled
Line 15—Box pressure, total, lb.	101,234	179,377	250,333	330,532
Line 16—Horizontal bearing pressure, lb. per sq. in.	1,349	2,174	2,782	3,390
Line 17—Ratio, horizontal to vertical bearing pressures	7.731	13.175	18.671	24.926

These figures are based upon full boiler pressure. It is fair to assume that the average M. E. P. of a freight engine in going over a division will be close to one-half boiler pressure, so we will divide the figures in line 17 by 2 and get the ratio of probable horizontal wear to probable vertical wear, which for the four-coupled engine is 3.865; for the six-coupled, 6.587: for the eight-coupled, 9.335; and for the ten-coupled, 12.463.

Now, the question arises: How can any one expect to maintain driving boxes, which wear in the horizontal direction, nearly 12½ times as fast as they do in the vertical direction? One should find no great difficulty, in arriving at the conclusion that this is a well nigh impossible proposition, even with crown bored brasses, as it has proved to be in practice.

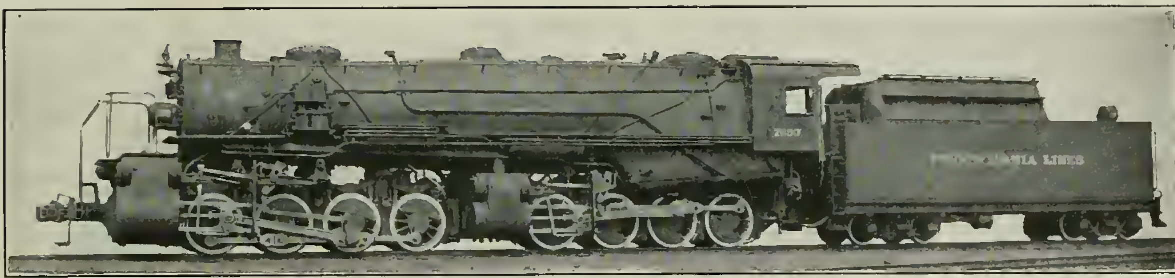
Now, let us see just what the practice of crown boring referred to by Mr. Murdock would do for the ten-coupled engine. A safe figure for bearing pressure per square inch is 200 lb. in driving boxes of freight engines.

The live load on the main journal is 26,650 lb., and on the basis of 200 lb. per sq. in. we find that we may safely reduce the vertically projected area of the bearing to 133¼ sq. in. This calls for a crown bore 5 in. wide by 12¼ in. long, and in boring the crown we have reduced the bearing area in the horizontal direction, owing to the fact that the crown bore extends downward ½ in. If ½ in. full bearing is left on each end of the brass to prevent the escape of grease the projected bearing area in the horizontal direction is 91⅜ sq. in. Dividing 330,532 lb. by 91⅜, the bearing pressure per sq. in. is found to be 3,617 lb., and the ratio of probable horizontal wear to probable vertical wear becomes 9.042. This is a betterment of 27½ per cent at the start, but it must be remembered that as wear progresses the projected area of the crown bearing will be increased in area. At any rate, the improvement thus effected has been so entirely negligible that several roads have abandoned the practice.

The writer had no idea that the rearrangement of the bearing surfaces which he suggested in his former letter would go, as it has, practically unchallenged. The most obvious difficulty with the arrangement shown lies in the fact that a very slight vertical wear would throw the lower portion of the thrust brasses out of contact with the journal and render them useless, after which the box would wear open just as fast as the half-shell type. The writer believes, however, that there is no good reason why the box should not be made sectional, say in three pieces, one to embrace a crown brass and carry the weight, while cheek plates embracing thrust brasses would be arranged at the front and back of the journal in such manner as to take care of the thrust and pull from the piston. With a box of this description it would be necessary to interlock the pieces, so that they would be incapable of any movement relatively to each other, except that necessary to close and open the bearings. To take up slack and stop a pound, set up the wedge on the engine frame. When a pre-determined limit of take-up has been reached, put shims behind the brasses to restore the original box dimension, then set up the wedge as before. The writer can see no reason why an engine should ever be taken off its wheels except to true up the tires and journals, as the brasses could be slip fits in their recesses and could be renewed whenever necessary. The box could be removed from the frame without dropping the wheels or removing the rods. This should be convenient when taking up lateral motion.

Inadequate main boxes is a most important subject, relative to the maintenance of locomotives and the mere mention of it should provoke the liveliest of discussions. The writer sincerely hopes to see more of it in future issues of your valued paper. CHARLES F. PRESCOTT.

NEW METAL ALLOY.—Trade Commissioner H. C. MacLean, at Rome, has sent a report to the Department of Commerce of a new alloy of zinc and copper which has been given the name of Biakametal. This alloy quickly demonstrated its usefulness in Italian industry, and by reason of its special qualities promises to attain similar success throughout the world. Metallurgists have made every effort to determine its exact composition, but without success. It is stronger than steel and less corrosive than copper. The most important characteristics are said to be the highest known breaking point, the highest limit of elasticity, perfect homogeneity, high resistance to thermic action and high resistance to chemical action.



Pusher Mallet Locomotive for the Pennsylvania Lines

Penn. Lines Mallet Locomotive

For Pusher and Hump Yard Service; 51-in. Wheels and 28-in. Stroke; 100,000 lb. Tractive Effort

The Pennsylvania Lines West of Pittsburgh has recently received from the Baldwin Locomotive Works 10 Mallet locomotives of the 0-8-8-0 type, which are designated by the railroad as Class CC-2-s. These locomotives are designed for heavy pusher and hump yard service and some idea of the severe conditions which they are required to meet is conveyed by the fact that they develop a tractive effort of 100,000 lb. The maximum grade in the hump yards on the Pennsylvania Lines is 3½ per cent, but the new Mallets are designed for operation on grades as steep as five per cent and on curves of 18 deg.

In the design of these locomotives there are a number of departures from well established Pennsylvania standards and in many respects the practice of the builders has been followed. The locomotives have conical wagon top boilers with radial stayed fireboxes instead of the Bellpaire type generally used on Pennsylvania power. The boiler has an outside diameter at the first ring of 88½ in., increased by the conical second course to an outside diameter of 100 in. at the throat sheet course. The firebox has an inside length of 144⅛ in. and is 96¼ in. wide. A barrel combustion chamber extends forward into the boiler 38½ in. from the vertical flange of the inside throat sheet. The tubes and flues have a length of 22 ft. and are 2¼ in. and 5½ in. in diameter, respectively. The boiler is also equipped with a 52-element Type A superheater.

Three rows of Baldwin expansion staybolts support the front end of the crown sheet. The arch is supported on five tubes and the locomotive is fired by a Duplex stoker. The throttle is of the inside connected type with the operating rod extending through the back head on the vertical center line; the throttle is equipped with an auxiliary drifting valve.

The wheels are of comparatively small diameter, measuring 51 in. over the tires and the low pressure cylinders are placed on an inclination of 1 in 35 in order to provide sufficient clearance above the rail. The high pressure cylinders are 26 in. in diameter and the low pressure 40 in. in diameter. A 28-in. stroke was made necessary by the small diameter of the drivers. Steam distribution is controlled by 14-in. piston valves for both the high and low pressure cylinders and the engines are fitted with the Simplex type of intercepting valve with auxiliary high pressure exhaust to the stack. The Walschaert valve motion is used throughout and the motion is controlled by the Ragonnet type *B* reverse gear.

The main driving axles have 10½-in. journals, while the journals of the other axles are 10 in. in diameter. All journals are 14 in. in length. The driving axles are of heat treated steel and are hollow bored. Heat treated steel is also used for the crank pins and the connecting and coupling rods. All driving tires are flanged.

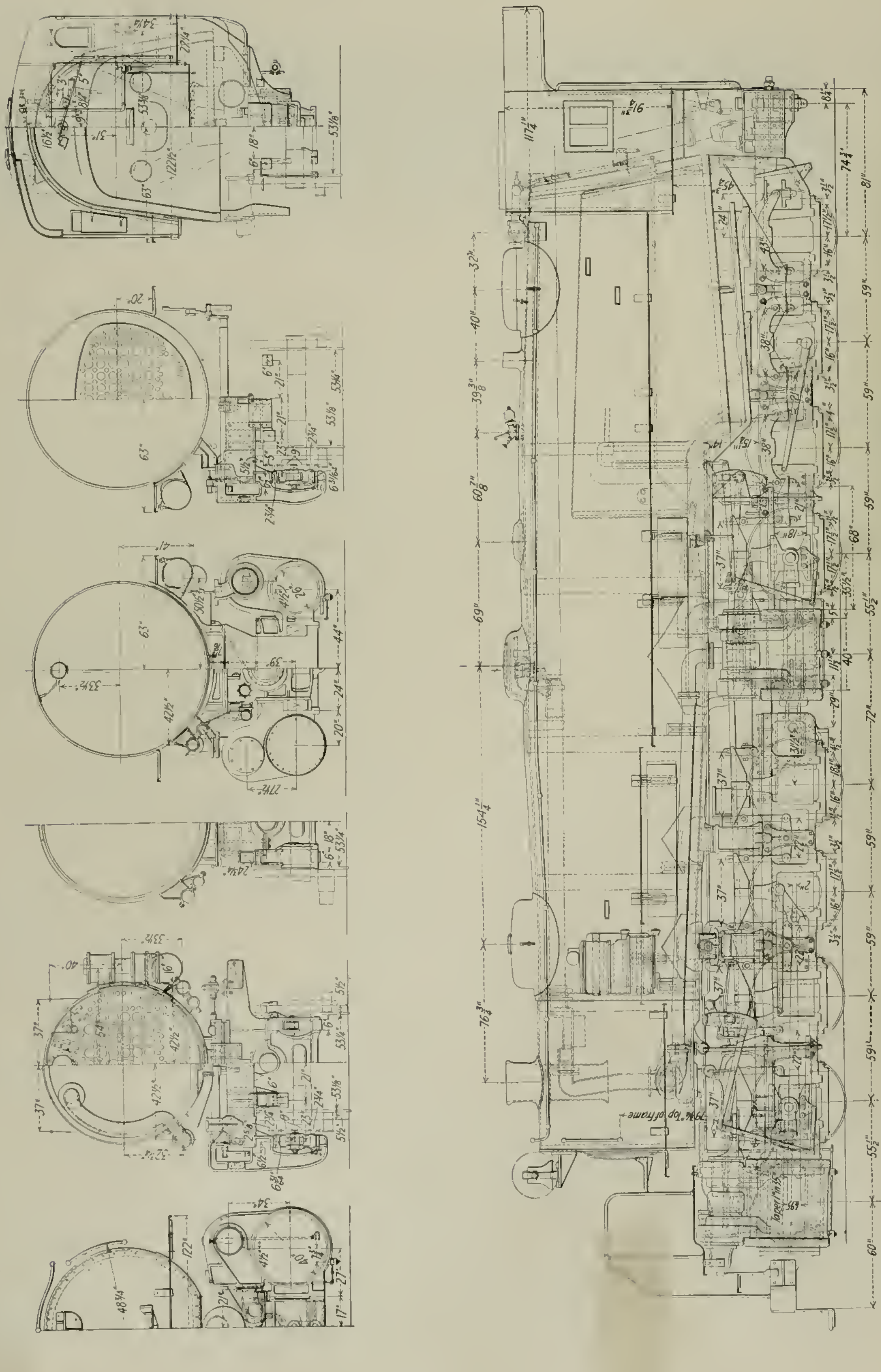
The equalization of the rear group of wheels is continuous on each side of the locomotive. In the case of the front group the springs of the leading wheels are cross equalized at the forward ends and attached to the frames at the rear ends. Those of the remaining three pairs of wheels are equalized together on each side.

Although the cab deck is roomy, the cab itself, in accordance with recent Pennsylvania practice, is comparatively short and the steam turret is placed outside and immediately in front of the cab. Two sand boxes are provided, one mounted over the first barrel course and the other above the firebox wrapper sheet just ahead of the cab. These are arranged to deliver sand to the rails at either the front or rear of each group of driving wheels.

The tender is built up with a one-piece cast steel frame and the tank is so designed that a water scoop subsequently can be applied if desired.

The following table presents the principal dimensions and data for these locomotives:

General Data	
Gage	4 ft. 8½ in.
Service	Pusher
Fuel	Bit. Coal
Tractive effort	100,000 lb.
Weight in working order	458,140 lb.
Weight on drivers	458,140 lb.
Weight of engine and tender in working order (est.)	650,000 lb.
Wheel base, driving	40 ft. 1½ in.
Wheel base, rigid	14 ft. 9 in.
Wheel base, total	40 ft. 1½ in.
Wheel base, engine and tender	78 ft. 8½ in.
Ratios	
Weight on drivers ÷ tractive effort	4.6
Total weight ÷ tractive effort	4.6
Tractive effort × diam. drivers ÷ equivalent heating surface*	714.4
Equivalent heating surface* ÷ grate area	74.1
Firebox heating surface ÷ equivalent heating surface,* per cent	5.5
Weight on drivers ÷ equivalent heating surface*	64.2
Total weight ÷ equivalent heating surface*	64.2
Volume equivalent simple cylinders	24.2 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	294.5
Grate area ÷ vol. cylinders	4.0
Cylinders	
Kind	Compound
Diameter and stroke	26 in. and 40 in. by 28 in.
Valves	
Kind	Piston
Diameter	14 in.
Wheels	
Driving, diameter over tires	51 in.
Driving, thickness of tires	3½ in.
Driving journals, main diameter and length	10½ in. by 14 in.
Driving journals, others, diameter and length	10 in. by 14 in.
Boiler	
Style	Conical
Working pressure	225 lb. per sq. in.
Outside diameter of first ring	88½ in.
Firebox, length and width	144⅛ in. by 96¼ in.
Firebox plates, thickness	Sides, back and crown, ⅜ in., tube, ⅝ in.



Elevation and Cross Sections of Pennsylvania Lines 0-8-8-0 Mallet Type Locomotive

Firebox, water space	Front, 6 in.; sides and back, 4½ in.
Tubes, number and outside diameter	209—2¼ in.
Flues, number and outside diameter	52—5½ in.
Tubes and flues, length	22 ft.
Heating surface, tubes and flues	4,639 sq. ft.
Heating surface, firebox, including arch tubes	391 sq. ft.
Heating surface, total	5,030 sq. ft.
Superheater heating surface	1,406 sq. ft.
Equivalent heating surface*	7,139 sq. ft.
Grate area	96.3 sq. ft.
Tender	
Tank	Water bottom
Frame	cast steel
Weight (estimated)	192,000 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	20 ton

*Equivalent heating surface = total evaporative surface + 1.5 times the superheating surface.

LAME ENGINES AND THEIR EFFECT ON FUEL CONSUMPTION*

BY J. W. HARDY
Fuel Supervisor, United States Railroad Administration

The purpose of this paper is to show in a practical way how fuel is wasted by lame engines (engines with valves out of adjustment). With this end in view tests were made on the Southern Pacific between Houston and Galveston.

The engines used were of the following dimensions:

Engine 267 was of the 4-4-0 type having a total weight of 137,425 lb., weight on drivers 91,675 lb. and tractive effort of 21,240 lb. The cylinders were 20 by 24 in. The valves 12 in. diameter inside admission piston type. The valve motion was the Stephenson link, set as follows: valve travel 6 in., 1⅛-in. lap, 3/32-in. exhaust clearance, line and line in front motion and ⅛ in. lead in back motion.

The engines were equipped with superheaters and burned fuel oil.

Engine 265 was of practically the same design and dimensions with the exception that the cylinders were formerly equipped with slide valves which were replaced with piston valves, simplified steam chests with 10 in. diameter valve outside admission having 1-in. lap, 1/32-in. lead in forward motion, 1/32-in. back, and 1/16 in. exhaust clearance.

The engines in these tests were run eight trips in each case with one exception, test No. 2. The test was conducted with Engine 267, which had considerable lost motion in its valve gear, and had made 16,700 miles since last shopping. Engine 265 was in the best of condition, having been turned out of the shops after being generally overhauled and superheated. The same engineer and fireman were used throughout the entire test.

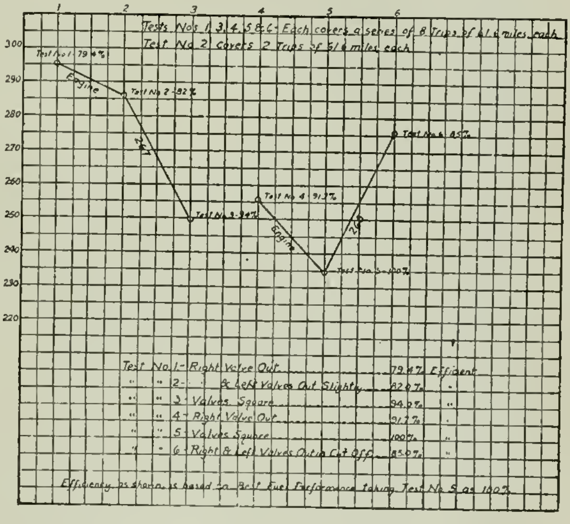
The tests made numbered from 1 to 6 inclusive—test Nos. 1 to 3 with engine 267 and 4 to 6 with engine 265. There were many places where we could get the lame engine, but we could not get the other conditions necessary to prove waste due to improper valve adjustment. We thought it was easier, better and more reliable to make changes on the engine than to attempt to work out the other conditions, many of which we had no control over.

The objects of the tests were to determine the fuel wasted by locomotives with valves out of adjustment, and to see how lame a locomotive could be without loss of time or complaint on its condition. Where an engine is so lame it cannot make time or handle its tonnage, it immediately attracts the attention of the transportation department and is taken in and repaired. It is only in rare cases that engines go lame all at once. When this occurs there is usually something lost, slipped or broken. This is noticed at once and is taken care of at the earliest possible moment; but, where the change takes place slowly and gradually, as it does by age and wear, we become more and more accustomed to it, and it is allowed to go on day after day and week after week wasting fuel all the time.

An oil burner was selected because a more accurate check could be made of the fuel used than with the coal burner. Measurements were taken just before starting, and on arrival, so that oil and water used represents what was actually used in pulling the train and making station stops. All conditions of engines and service were kept as near the same as possible, except the valve adjustment, which is shown at the heading of each test made.

There was a total of 5/16 in. lost motion in the valve gear of engine 267, but this was pretty well distributed, the engine not lame enough in any case to affect the schedule of the train. There was a noticeable kick in the engine when lame that was not there when squared.

With the slight change in valve adjustment shown between tests 1 and 3, there was a difference of 18.33 per cent in the fuel consumed; no other charge can be made of this loss of fuel than to the condition of valves. The waste would undoubtedly increase with heavier service or more distorted valve condition; this is proved by test No. 6 with engine 265. Test No. 2 is not recorded for the purpose of comparison, but to show the condition of valves after the engine was squared up by the travel at full stroke and pronounced O. K.



Relation of Fuel Consumption to Valve Setting

More throttle had to be used with the engine in this condition than when the valves were as in test No. 3.

The valves govern the application of the power of steam to the locomotive and are of great importance to fuel consumption. It takes fuel to generate power, and it means a waste of fuel if this power is improperly used in the cylinders of our locomotives. The exhaust action is different when the engine is lame, causing a pulsating draft instead of a regular and constant pull on the fire. This wastes fuel in addition to the improper application of the power to the machine. Square engines steam better than lame ones, although these engines steamed well in both cases.

Valves out of square in a measure take the economical operation of the locomotive out of the hands of the crew. Their hands are practically tied because they are robbed of the control of the power applied to the locomotive in their charge. With an indifferent crew this loss will increase.

There is no way that we know of where we can get as good returns, and get them as quickly and at as little cost, as by squaring valves. It only costs a few dollars more to do

*Abstract of a paper read before the International Railway Fuel Association at the convention in Chicago, May 19-22, 1919.

this work well; it only costs a few dollars to do it at a time when it is needed and should be done, and it will often begin to pay dividends the first trip after it is done. Transportation people should want it done because the engine will pull more and pull out less draw bars when square than when lame, because the power is more evenly distributed in the cylinders and helps to prevent lunging and jerking when starting. The mechanical department people should do it because it cuts down fuel waste and the cost of locomotive maintenance. The crew should want it done because it makes their work easier and more pleasant.

There is liable to be less complaint on a lame oil burner, especially if she steams, than on a coal burner on account of less manual labor to fire the oil burner. Why spend money for brick arches, superheaters, etc., and then waste as much with valves out as we can save with both of them? Why spend money to generate steam and then not control its use? You can go to any union station or large freight yard and hear engines pulling out every day on long, hard and heavy runs that sound worse than either of these engines did. The question of proper valve adjustment is so important that it should be specialized on.

The cut-off and steam distribution on test No. 2 with engine 267 merits careful study. This engine was run over at full stroke; in fact, was more carefully gone over than this work is usually done; pronounced O. K., and, no doubt, under ordinary circumstances, would have run possibly for months in this condition. Note how much better this engine did in test No. 3 with valves properly adjusted and a little of the lost motion taken up.

The difference in the performance of engine 267 with valves lame and square was so much we decided to make a test with an engine having as little lost motion in the valve gear as possible. We therefore arranged for a test with engine 265. This engine was new, and when broken in the right go ahead blade was changed so the cut-off was as shown in test No. 4. This engine was quite lame only on one side, and this low down in the quadrant, and, as the lever was hooked up, it got better. As the engine did most of its work at close cut-off, this change only made a difference of about 9¼ per cent in the fuel used, but the engine had a very disagreeable kick on the right side when run at high speed and short cut-off.

Certain kinds of lameness are more wasteful than other kinds. The engine that is lame where it uses the most of its steam is the most wasteful. This is clearly brought out by test No. 6 with engine 265. By changing the back motion blades so that the engine cut-off in the forward motion, this engine was made lame in the cut-off where most of its work was done.

In all tests where the engines were lame, the lameness was aggravated by its being more difficult to keep the valves lubricated, and both engines rode much harder while lame than when squared. An engine can sound square and still have valves improperly set. A condition of this kind can only be discovered by careful measurements.

My conclusions from these tests are that a waste of as much as 25 per cent of the fuel could be made by further distortion of valves before the engines would begin to lose time or affect the train service.

Conditions Surrounding Tests Nos. 1 to 6, Inclusive, with Cut-off at 6-In. Piston Travel.

Test No. 1, Engine No. 267. Right valve out—cut-off—right side, front 5 1/16 in., back 10 7/16 in. Left side, front 7¼ in., back 7¾ in.

Test No. 2, Engine No. 267. Both valves out—cut-off—right side, front 7 1/16 in., back 5 1/16 in. Left side, front 7 1/16 in., back 5 7/16 in.

Test No. 3, Engine No. 267. Both valves square.

Test No. 4, Engine No. 265. Right valve out—cut-off—right side, front 8½ in., back 3½ in. Left side, front 6½ in., back 6 13/16 in.

Test No. 5, Engine No. 265. Both valves square.

Test No. 6, Engine No. 265. Both valves out—cut-off—right side, front 3 11/16 in., hack 8 7/16 in. Left side, front 4⅛ in., back 7 13/16 ni.

Per cent increase in fuel consumption Test No. 1—18.33 per cent.

Per cent increase in fuel consumption Test No. 2—14.63 per cent.

Per cent efficiency of engine in Test No. 1, considering engine in Test No. 3 as 100 per cent—84.5 per cent.

Per cent efficiency of engine in Test No. 2, considering engine in Test No. 3 as 100 per cent—84.5 per cent.

Per cent increase in fuel consumption Test No. 4—9.12 per cent.

Per cent increase in fuel consumption Test No. 6—17.70 per cent.

Per cent efficiency of engine in Test No. 4, considering engine in Test No. 5 as 100 per cent—91.6 per cent.

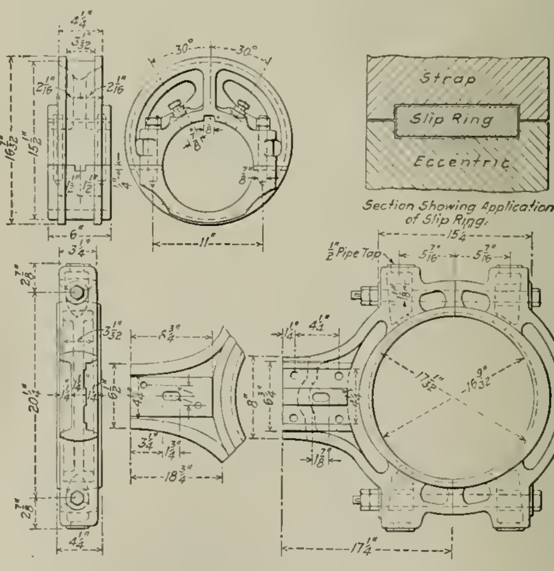
Per cent efficiency of engine in Test No. 6, considering engine in Test No. 6 as 100 per cent—84.9 per cent.

ECCENTRIC WITH FLOATING LINER

BY J. A. PULLAR

A simple and economical method of utilizing old eccentric cams is illustrated in the drawing. A 17-in. eccentric cam is turned down to 15½ in. diameter leaving a ⅜-in. flange on each side, thus forming a groove to hold a floating liner or slip ring as shown in section. The outside of the ring fits in the eccentric strap just as the old eccentric cam did.

Four rings are turned at one time from a brass bushing 14 in. long, which allows for clamping and cutting the rings. Each ring has three oil holes equally spaced and is



Eccentric Cam With Slip Ring in Place

cut in three parts on a milling machine by cutting through the center of the oil holes.

The eccentric cam can be turned down to fit the rings in the same length of time it would take to fit a new cam on the journal and considerable machine work and labor is avoided by using the old cam.

Eccentric cams converted as described have proved very successful and wear longer than when applied in the old way. The use of the ring has eliminated the usual trouble of closing the eccentric strap after every few trips and when worn the ring may be renewed in a very short time, while it would take several hours to fit a new eccentric cam and key.

Car Department Forces to be Increased.—On account of the fact that the number of bad order cars has increased considerably at the Nashville shops of the Nashville, Chattanooga & St. Louis, the forces in the car department are to be materially increased. It is understood that the additional men needed to put these cars in good condition for shipping will be drawn from the ranks of those recently laid off.

Shopmen's Wage Increase Refused

President Agrees with Director General that Demands Are Unjustified Under Present Conditions

THAT there shall be no new cycle of wage increases for railroad employees under present conditions is the decision of President Wilson and Director General Hines on the demands presented by the committee of the shopmen's unions. This conclusion was reached on the ground that the increases already granted by the Railroad Administration and by the railroad companies during the two years preceding federal control have kept pace with or exceeded the increase in the cost of living up to date, and that further advances in railroad wages are not warranted by comparison with other wages, and would merely result in a further increase in the cost of living, which the government is now bending every effort to reduce.

Whether this decision will be accepted by the labor organizations, however, will not be known until the counting of the new strike vote called for by the leaders following their formal rejection of the small increase granted the men by way of readjustment.

Following the submission to Congress by President Wilson on August 1, of his recommendation for legislation creating a tribunal for the investigation and determination of all questions concerning the wages of railway employees, the responsibility for settlement of the questions arising from the shop crafts' demands was placed squarely on the shoulders of the President and Director General by the unanimous decision of the Senate committee on interstate commerce that the President already possessed "complete and plenary authority" in the premises.

Therefore, on assurances that the 40,000 men estimated by union officials in Washington to have walked out in the unauthorized local strikes following the reference of the wage question to Congress, had returned to work, conferences were resumed on August 20 between the shop employees' representatives, headed by B. M. Jewell, and the Railroad Administration. On August 23 Director General Hines gave the President a complete report of his recommendations for a settlement and on August 25 the shopmen's committee, which had just completed the count of a vote authorizing the calling of a strike unless their demands were granted, was called to the White House to receive the final decision from the President. The shop employees were awarded an increase of 4 cents an hour, retroactive to May 1, more as an adjustment than as a direct wage increase.

At this conference a copy of Mr. Hines' report, and two statements by the President, one to the shopmen and one to the public, were given out.

THE PRESIDENT'S STATEMENT TO THE PUBLIC

In his statement to the public, President Wilson briefly reviewed the steps by which the settlement had finally been placed in his hands, then taking up the grounds on which the men had justified their demands. In discussing the high cost of living in this connection he made a strong plea for sober second thought on the part of all wage earners to the end that adjustments to meet living costs be postponed until normal conditions are restored and adjustments can be made on a more certain basis.

"Demands unwisely made and passionately insisted upon at this time," the President said, "menace the peace and prosperity of the country as nothing else could, and thus contribute to bring about the very results which such demands are intended to remedy."

THE PRESIDENT'S STATEMENT TO THE SHOPMEN'S COMMITTEE

In addressing the Committee of the shopmen's unions the President said:

I request that you lay this critical matter before the men in a new light. The vote they have taken was upon the question whether they should insist upon the wage increase they were asking or consent to the submission of their claims to a new tribunal, to be constituted by new legislation. That question no longer has any life in it. Such legislation is not now in contemplation. I request that you ask the men to reconsider the whole matter in view of the following considerations, to which I ask their thoughtful attention as Americans, and which I hope that you will lay before them as I here state them.

We are face to face with a situation which is more likely to affect the happiness and prosperity, and even the life, of our people than the war itself. We have now got to do nothing less than bring our industries and our labor of every kind back to a normal basis after the greatest upheaval known to history, and the winter just ahead of us may bring suffering infinitely greater than the war brought upon us if we blunder or fail in the process. An admirable spirit of self-sacrifice, of patriotic devotion, and of community action guided and inspired us while the fighting was on. We shall need all these now, and need them in a heightened degree, if we are to accomplish the first tasks of peace. They are more difficult than the tasks of war—more complex, less easily understood—and require more intelligence, patience and sobriety. We mobilized our man power for the fighting, let us now mobilize our brain power and our consciences for the reconstruction. If we fail, it will mean national disaster. The primary first step is to increase production and facilitate transportation, so as to make up for the destruction wrought by the war, the terrible scarcities it created, and so as soon as possible relieve our people of the cruel burden of high prices. The railways are at the center of this whole process.

The government has taken up with all its energy the task of bringing the profiteer to book, making the stocks of necessaries in the country available at lowered prices, stimulating production, and facilitating distribution, and very favorable results are already beginning to appear. There is reason to entertain the confident hope that substantial relief will result, and result in increasing measure. A general increase in the levels of wages would check and might defeat all this at its very beginning. Such increases would inevitably raise, not lower, the cost of living. Manufacturers and producers of every sort would have innumerable additional pretexts for increasing profits and all efforts to discover and defeat profiteering would be hopelessly confused. I believe that the present efforts to reduce the cost of living will be successful, if no new elements of difficulty are thrown in the way, and I confidently count upon the men engaged in the service of the railways to assist, not obstruct. It is much more in their interest to do this than to insist upon wage increases which will undo everything the government attempts. They are good Americans, along with the rest of us, and may, I am sure, be counted on to see the point.

It goes without saying that if our efforts to bring the cost of living down should fail, after we have had time enough to establish either success or failure, it will of course be necessary to accept the higher cost of living as a permanent basis of adjustment, and railway wages should be readjusted along with the rest. All that I am now urging is, that we should not be guilty of the inexcusable inconsistency of making general increases in wages on the assumption that the present cost of living will be permanent at the very time we are trying with great confidence to reduce the cost of living and are able to say that it is actually beginning to fall.

I am aware that railway employees have a sense of insecurity as to the future of the railroads and have many misgivings as to whether their interests will be properly safeguarded when the present form of federal control has come to an end. No doubt it is in part this sense of uncertainty that prompts them to insist that their wage interests be adjusted now rather than under conditions which they cannot certainly foresee. But I do not think that their uneasiness is well grounded. I anticipate that legislation dealing with the future of the railroads will in explicit terms afford adequate protection for the interests of the employees of the roads; but, quite apart from that, it is clear that no legislation can make the railways other than what they are, a great public interest, and it is not likely that the President of the United States, whether in possession and control of the railroads or not, will lack opportunity or persuasive force to influence the decision of questions arising between the managers of the railroads and the railway employees. The employees may rest assured that, during my term of office, whether I am in actual possession of the railroads or not, I shall not fail to exert the full influence of the Executive to see that justice is done them.

I believe, therefore, that they may be justified in the confidence that hearty co-operation with the government now in its efforts to reduce the cost of living will by no means be prejudicial to their own interests, but will, on the contrary, prepare the way for more favorable and satisfactory relations in the future.

I confidently count on their co-operation in this time of national test and crisis.

DIRECTOR GENERAL HINES' REPORT

Mr. Hines' report to the President, dated August 23, is as follows:

In view of the importance both to the railroad employees and to the public of the wage demands of the shop employees, and in view of the intimate relationship between that subject and the all-important subject of the cost of living, I feel it my duty to make this report to you for action by you if you wish to take personal action in regard to it.

The responsibility rests upon me to decide upon its merits the claim of the railroad shopmen for the following increases in wages:

	Now receiving Cents	Requested Cents	Increase Cents
Machinists	68	85	17
Toolmakers	68	90	22
Boilermakers	68	85	17
Riveters	68	85	17
Blacksmiths	68	85	17
Sheet metal workers	68	85	17
Electricians	68	85	17
Car inspectors	58	85	27
Car repairers	58	85	27
Car repairers, steel	63	85	22
Helpers	45	60	15

Note.—These figures represent only the principal classes.

This demand was considered by the Board of Railroad Wages and Working Conditions, a board constituted last year by the Railroad Administration to consider wage matters, and consisting of three representatives of labor and three representatives of the railroad managements. On the question of any general increase to the shopmen, the board divided equally, the three labor members favoring an increase to a basis of 80 cents and the three management members opposing any general increase whatever, although expressing the opinion that unless the cost of living could be controlled, there would need to be a further general increase in wages. This is the first time when this board has thus divided on the question of a general wage increase presented to it. In every other case the board has been in agreement upon the proposition that there ought to be a general increase, although in some cases its members have been slightly apart as to the extent of the general increase. In this case three members of the board, who in all other cases have been in favor of a general increase, have thus opposed any increase whatever for the entire class of employees.

I believed it would be more satisfactory both to the employees and to the public to have this grave problem considered and disposed of by a commission created by new legislation. Recommendation to that effect was submitted to the appropriate committees of the Senate and the House, but the unanimous adverse action of the Senate committee made it clear that such a course would not be pursued.

It is also true that the employees themselves vigorously objected to my suggestion and insisted that the matter should be decided by me.

Since the subject must be dealt with, and no other method has been or is to be provided, it follows that it must be dealt with by the director general under the powers conferred upon the President by the Federal control act, and this must be done without the aid of any action by the wage board.

I approach this matter with the clearest conviction that the railroads must be conducted now and for all time in the future in such a way as to give to railroad employees an adequate compensation and a liberal share in the returns from railroad operation. This is not only justly due to the employees who make possible the rendition of the service but it is obviously in the interest of good service. It is true now, and will be true to a continually increasing extent in the future, that a state of contentment on the part of railroad labor will be indispensable to efficient railroad service and this contentment cannot exist unless the evidence of fair treatment is so clear that it will carry conviction to the railroad employees themselves.

I have, after the most careful possible study, and after considering everything presented on behalf of the railroad shop employees, reached the following conclusions:

The main contention of the shop employees is that their demands are just because of the rates paid in the ship yards, navy yards and arsenals. The basic rate in the ship yards was 80 cents at the time the shopmen presented their demands, and an increase effective October 1 next has just been made in an agreement (to which the government was in no way a party) between the employees and the ship builders on the Pacific coast. After the most careful consideration, I can see no escape from the conclusion that the rates paid in the shipyards cannot be adopted as a measure for the rates to be paid in the railroad shops. The conditions are fundamentally different. The work performed by employees classed as railroad shop employees is performed in every city and in every railroad town of considerable size in the United States. The principal railroad shops are not in the largest cities and many of the principal shops are in towns or cities of relatively small size. At the urgent instance of the employees, the rates for all these shopmen throughout the United States, whether in large cities, small cities or towns or virtually rural communities, have been standardized on uniform bases. It cannot be, therefore, that these standardized rates can be put so high as to reflect the conditions prevailing in the relatively few industrial centers where shipbuilding was developed under high pressure during the war. Not only are the shipyards practically without exception in densely populated centers but employees had to be attracted to those yards in time of war in competition with munition plants and others paying exceptionally high wages, and the employees who were attracted to those yards had to establish themselves in these densely populated centers with particularly costly living conditions. In order to meet the keen competition of other war industries and to build up the forces of men in the shipyards exceptional rates had to be provided.

The work in the railroad shops not only offers year in and year out (despite the fluctuations incident to changes in the volume of business) reasonably steady employment, but also offers a practically permanent career. On the other hand shipbuilding represents to a large extent a temporary employment. This is brought out clearly by the following showing which is actual up to August 15, 1919, and estimated beyond that date, as to the employees who have been and will be employed in the shipyards so far as the present governmental program is concerned.

Date	Number of shipbuilders	Date	Number of shipbuilders
January, 1914	48,700	June, 1919	354,625
January, 1916	78,100	Dec. 31, 1919	250,894
January, 1918	144,600	June 30, 1920	230,000
November, 1918	373,622	Dec. 31, 1920	153,000
January, 1919	361,211	June 30, 1921	0

Note.—These figures do not include, as I understand it, members of office forces, but only include the men engaged in ship construction and men employed in fabricating shops and all other shops actually a part of the shipyard plant.

It is perfectly clear to me that the people of the United States cannot be committed to the policy that the wages of railroad shopmen in every city, town and village in the United States must be brought up to a basis created in an emergency and in a largely temporary war undertaking, concentrated in a comparatively few densely populated industrial centers where living conditions are exceptionally expensive and difficult, so that I conclude that the principal contention of the shop employees cannot be adopted.

Of course if the employees themselves were willing to accede to a plan whereby the wages of railroad shopmen in each community should be made with reference to the average wages in that community, other considerations would have weight. But the employees are insistent that the same wage scale shall be paid in every place in the United States, regardless of its size or of local living conditions, and as this principle has been adopted it necessarily follows that exceptional conditions in exceptional communities cannot be taken as the standard for the wages of railroad shopmen.

The conditions in the navy yards and arsenals cannot, largely for the reasons already stated, be taken as controlling; moreover, it has generally been recognized that the rates therein should reflect local conditions in the particular communities and they have not been standardized at all except for a temporary standardization for the war to correspond with the shipyard rates.

It is further urged by the employees that the rates they receive are below those paid in private industries for similar labor. The employees cite various instances of rates in excess of 80 cents for work of this character, but these citations merely refer to conditions in specific communities. It must also be remembered that to a large extent private industries themselves were influenced to an exceptional degree by the war conditions, enjoying the most exceptional profits and paying unusually high wages to meet emergency requirements. But no convincing evidence has been presented that the average of the wages paid in private industries generally, or in those paying union scales of wages, throughout the United States for similar labor was or is substantially higher than the rates paid by the Railroad Administration.

I myself have collected the available information from the Department of Labor and that indicates that the average rate paid the principal metal trades in private industries, having union scale of wages, was at May 15, 1919, probably not more than 3 cents in excess of the 68 cent rate paid to the railroad shop employees. It is a question whether even as to private industries the advantages of work in railroad shops, including the advantage of substantial amounts of free transportation, do not make it reasonable for the railroad shops to have a differential under the rates paid in other private industries. This question, however, need not be decided because the decision made below will make the rates for the railroad shop employees in excess, if anything, of average rates shown in the evidence thus obtainable from the Department of Labor for private industries.

In making comparisons for work of similar character between wages in the railroad industry and wages in private industries, due consideration must always be given to the fact that private industries are frequently able to increase their prices to the public without difficulty to offset, and more than offset, increases in wages, so that to a very considerable extent the wages fixed in private industries are fixed without any representation, either direct or indirect, of the general public which eventually must pay the bill. On the contrary the railroads whether under public or private control cannot increase the prices they charge, i.e., their transportation rates, except with the sanction of public authority. So the question must be viewed from the public standpoint as well as from the standpoint of the employees. This necessitates the most careful scrutiny of rates of pay which have been fixed by industries enjoying tremendous profits which are not subject to public control. Of course the wages paid railroad employees must be not only reasonable in themselves but reasonably satisfactory to the employees, and necessarily the general average rates normally paid elsewhere in permanent private industries for similar services, are an important factor for consideration. But the distinguishing conditions must never be ignored.

The further claim is made that the cost of living has increased. In a letter of August 5, 1919, signed by the executives of the six railroad shopmen's organizations, and also by the executives of the eight other organizations of railroad employees, including the various organizations of train and engine men, of telegraphers, maintenance of way men, and clerks, the proposition is laid down that railroad employees are entitled to compensation which will, at least, re-establish the pre-war purchasing power of their wage.

The way to re-establish the pre-war purchasing power of wages is to reduce the cost of production and not to increase it.

The government is now taking vigorous steps to reduce the cost of living and is meeting with gratifying progress. This great work would be arrested if not defeated through the present adoption of the policy of moving up wages so as to reflect fully what is probably the very top-notch of the high cost of living. Such a movement would tend to increase still further the cost of living and injure every working man as well as every other person in this country.

In a statement presented to the President on July 30, W. S. Stone, president of the Brotherhood of Locomotive Engineers, said:

"We believe the true remedy for the situation, and one that will result in lifting the burden under which the whole people are struggling is for the government to take some adequate measures to reduce the cost of the necessaries of life to a figure that the present wages and income of the people will meet. Should this not be considered feasible, we will be forced to urge that those whom we represent be granted an increase in wages to meet the deterioration of the purchasing power of the dollar, be that what it may, which can be easily determined by competent authority."

W. G. Lee, president of the Brotherhood of Railroad Trainmen, in a summary of a statement made by him before the Board of Railroad Wages and Working Conditions and given to the press by him on July 31, stated that an increase in wages was not the proper solution of the present economic stress under which working men are laboring because they will be followed by new increases of cost of everything which would more than absorb the additional pay.

I therefore believe it would be unfair for the general public, subversive of the efforts which the government is making to reduce the cost of living, and injurious to railroad employees themselves, for the Railroad Administration at this time to adopt the principle of moving up wages of all railroad employees so as to reflect the highest point yet reached in the high cost of living. Such action would mean inevitably an increase in freight rates which would stimulate an increase in the cost of everything consumed by the public and would give innumerable pretexts for covering up additional unwarranted increases in prices on the claim that such increases will be necessitated by the increased cost of railroad transportation. As a matter of fact the rates of pay and also the earnings of many subdivisions of classes of railroad employees have already been so advanced as to be ahead of the highest point yet reached in the general average increase in the cost of living in the country. Any effort to adopt that high point as the minimum level for all railroad wages will be highly detrimental to the public interest.

I have consistently urged throughout this calendar year that the greatest problem before the country is a reduction in the cost of living and one of the greatest obstacles in the way of such reduction would be substantial increases in transportation rates. I am convinced that it is not reasonable from the standpoint of the public and would not be beneficial from the standpoint of railroad employees to make an increase in wages in the effort to overtake the high cost of living, since the increase would thereby result in putting cost of living further out of reach and seriously obstruct the efforts now being made to bring down the cost of living.

In this connection it is proper to say that if railroad shop employees be viewed as a class it appears from the best data available that, comparing the total earnings of those employees now with their total earnings in the year ending June 30, 1915, the average increase in their earnings is somewhat in excess of the total increase in the cost of living from July 1, 1915, to August 1, 1919. This comes about by the fact that in carrying out the policy of standardization so strongly urged by the railroad employees great numbers of men employed in railroad shops were given the benefit of a higher classification which entitled them to wages much in excess of the increases indicated by the mere difference between the old rates of pay and the new rates of pay. While it is true that those railroad shop employees who enjoyed the highest scale of wages prior to the war may not have received an increase fully commensurate with the increase in the cost of living it is also true that great numbers of those employees have received increases substantially in excess of the increase in the cost of living. This condition however should afford no basis for the claim that the total increase already given to railroad shop employees is excessive, because I do not believe that such is the case. On the contrary, I believe the railroad shop employees were fairly entitled as a whole to the increases in wages provided and are also fairly entitled to the additional increase next below mentioned.

There has been insistent contention that while all other classes of railroad employees have had their wages adjusted in such manner that they receive an increase wage in addition to receiving 10 hours' pay (in the pre-war period) for eight hours' work, this same treatment was not accorded to the shopmen. While it has been urged with equal insistence that the shopmen got offsetting advantages, it seems to me it is true that in this specific matter the shopmen did not receive the benefit of equal treatment. On that account it seems to me fair in all the circumstances to recognize this condition by giving the shop employees a rate of 72 cents instead of 68 cents for the classes now receiving 68 cents.

Under Supplement 4 to General Order 27 and an addendum to that supplement, two different rates have been provided for car repairers, one a rate of 63 cents for steel freight car repairmen and another rate of 58 cents for wooden freight car repairmen. This distinction has been difficult to maintain and has been the source of dissatisfaction and there is general agreement among the members of the wage board that the condition ought to be remedied (although the labor representatives think it ought to be remedied by increasing the rates for all car repairers to the highest rates).

I therefore conclude, that, except as stated below, the rate for all freight car repairmen who by Supplement 4 to General Order 27 and the addendum thereto were intended to receive either 58 cents or 63 cents shall receive 67 cents per hour. There has been great dissatisfaction because car inspectors generally have received only the rate of 58 cents notwithstanding the fact that steel freight car repairmen have received the rate of 63 cents. My conclusion is that, except as below stated, car inspectors should receive the same rate as above indicated for freight car repairmen and therefore should receive 67 cents per hour.

The exceptions above referred to as to freight car repairmen and as to car inspectors are as to such employees at outlying points other than shops and main line terminals at which points the work, generally speaking, is not continuous. The increase for freight car repairmen and car inspectors at such outlying points will be 4 cents per hour. The determination as to the points where the freight car repairmen and car inspectors who according to this principle get only the 4 cents increase will be taken up in conference with the representatives of the shopmen with a view to arriving at a reasonable and definite working rule.

As to all other classes covered by Supplement No. 4 and not above specifically dealt with, the rate of increase shall be 4 cents per hour.

Ever since last September it has been the settled principle of the Railroad Administration to make wage orders retroactive to a date approximating the date upon which the Board of Railroad Wages and Working Conditions made its report and in this instance that report was made on July 16. The conditions here, however, are peculiar in that the action of the wage board has been delayed for an exceptional length of time, the presentation to the wage board having been made last February. In these circumstances it seems to me that, as a part of a negotiation of a national agreement, the changes above indicated could properly be made effective as of May 1, 1919, and the Railroad Administration is willing to make these changes in rates of pay effective as of that date for all employees who do not leave the service pending the completion and adoption of a national agreement with the shopmen's organizations.

SHOP EMPLOYEES TAKE NEW STRIKE VOTE

After ascertaining that this decision was final, the committee representing the shopmen, formally advised Mr. Hines on August 26 that they could not accept the offer, and an order was issued for a new strike vote. With the order were sent copies of the President's statement, at his urgent request, and also of Mr. Hines' proposition with the request that they be given most careful consideration at a summoned or called meeting of each craft. The letter to the officers and members of the unions calling for the vote stated that the director general had declared that the proposition was final and that there would be no wage increase granted to any other class of railroad employees as a class, but that in the event of unjust inequalities, as between individuals, adjustments involving increases to equalize rates of pay would be made where justified, except under the conditions stated in the fourth paragraph of the President's statement. The letter cautioned the men to consider their position very carefully and not overlook the following important facts:

In any general wage increase which may be granted the shop crafts will receive the same consideration as other classes of employees.

If a strike is authorized the shopmen will be striking alone to force an increase for all of the 2,000,000 railway employees.

Owing to the large number of members involved, the international organizations will not be obligated to pay strike benefits beyond the limits of the funds available for that purpose.

FUNCTIONS OF THE WAGE BOARD NOW LIMITED TO ADJUSTMENTS

Director General Hines has addressed a letter to A. O. Wharton, chairman of the Board of Railroad Wages and Working Conditions, to define the functions which it is appropriate for it to perform in view of the decision announced by the President. For the present these are confined to the consideration of claims of any class or subdivision of a class of railroad employees to the effect that readjustments ought to be made in order to bring about equality of treatment on the basis of the general principles of wage adjustment which the Railroad Administration has already established. The board is expected to report a statement of facts, its conclusions upon the facts and its recommendations.

MODERN TENDENCIES IN ROUNDHOUSE DESIGN*

BY EXUM M. HAAS
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An engine terminal is a clearing house for motive power, hence anything done to obviate delays tends to increase the traffic-carrying capacity of the road without increasing the fixed charges. The tremendous increases in traffic, operating charges, and hauling capacity of locomotives and their cost have proportionately increased the demand for full utilization of a locomotive's earning power. Mere minutes saved on each locomotive handled, when multiplied by the total number of locomotives of a given road, and reduced to money, will finance unbelievable improvements.

I refer to this phase of the engine terminal problem to indicate that a road can afford to pay for the most efficient facilities. As a matter of fact, a 100-engine terminal can be built at present day prices, and fully equipped, for $660,-000. This would result in annual fixed charges of about $69,300, at 10½ per cent for interest and depreciation, or at about $2 per engine per day. For a terminal of this size, a 20 to 25-stall roundhouse would be required. Assuming 24 stalls, the house would cost about $220,000, or about one-third of the terminal cost. This amount would provide a roundhouse, equipped with all the modern labor-saving facilities, and it could be sc constructed as to reduce depreciation to a minimum. For instance, a reinforced concrete structure would carry a rate of about 2½ per cent for depreciation, whereas a brick wall, wooden frame and roof structure would carry at least a rate of 5 per cent.

While the weight of locomotives has increased about 100 per cent, the cost has doubled. This also emphasizes the need for better facilities for the protection of the motive power. A locomotive is not a fire risk in itself, but when it is placed in a wooden roof roundhouse it certainly becomes one.

Some roundhouses are quite important running repair shops; hence anything incorporated in the design that will reduce the time to clear a locomotive should be adopted. Of course, there is an economical limit to the amount that can be spent, but that need not worry most of us, because there is so much room for improvement at most terminals that we would find it difficult to reach the limit of cost. For instance, engine terminal costs varied in 1918, so far as my knowledge goes, from $25,000 to $50,000 per stall of house capacity. The roundhouse proper has varied in cost from $6,000 per stall, with lighting, heating and plumbing, to $22,000 per stall. Both of these figures are high for the types of construction used, because of the abnormal labor and material market conditions prevailing in 1918, but the cost relation would hold even in normal times. On the other hand, from what I know of the labor-saving facilities provided in the higher-priced terminal and the permanence of its construction, I believe the mechanical department will have no difficulty in justifying the greater investment.

RELATION OF ROUNDHOUSE DESIGN TO LABOR

Another of the broader questions affecting roundhouse design at present is labor. This concerns the quantity and class of help available, and the working conditions and wages. Under prevailing industrial conditions intelligent labor has obtained employment at higher wages and with more satisfactory working conditions than are commonly found in and about a roundhouse. The roundhouse design must meet this form of competition or the quality of labor will fall below its present standard, and roundhouse labor is none too intelligent now.

Conditions in the average roundhouse built 20 years ago were not conducive to efficiency or economy. Poor day and night illumination and a lack of proper handling and machine tool equipment not only reduced the capacity of the house for clearing locomotives, but resulted in serious delays. On the other hand, the shortage of desirable help and the correspondingly higher prices that must be paid to obtain good men, make it important that all the facilities necessary and consistent with economy be provided to increase the production per man. The increased use of bridge and jib cranes in roundhouses is evidence of an appreciation of this fact. The substitution of the electric hoist for the truck and driver drop pits is another example. Improved daylighting in the working areas, and better heating and ventilation are also examples of the tendency to improve roundhouse conditions. Paved floors and walks, attention to good drainage, all add to engine terminal efficiency, and do not materially increase the fixed charges.

MODERN TYPES OF CONSTRUCTION

Modern roundhouses divide themselves into three classes—the brick wall, wood frame and roof; reinforced concrete frame and roof, and a combination of steel frame and reinforced concrete structure. In one or two instances, concrete frames with wooden roofs have been built to reduce first cost, and in others reinforced concrete unit construction was adopted. The brick wall, wooden frame and roof construction has been most generally used because of its cheapness.

A roundhouse located at an unimportant terminal, housing engines that are comparatively small, is usually of simple design. The present tendency, however, is to increase the height to improve daylighting and ventilation. Houses of this type should be built of slow burning construction throughout—nothing less than 2-in. sheathing, preferably 3-in., on 6 in. by 12 in. rafters and heavily coated with a fire-resisting paint.

On many roads the frequent post spacing has been found objectionable. This was the case with the New York Central Lines, and a 64-ft. truss has been substituted in the working area for the columns and beams. These trusses were formerly of heavy timber construction, but are now built up of bolted planks. The reason for this change was to cheapen the construction without reducing the quality of the lumber.

*Abstracted from a paper presented before the Western Society of Engineers, Chicago, May 12, 1919.

This house has a one-bay portal way, with a lean-to at the back of the house. The lean-to in the rear not only provides a working aisle, but also permits the locomotives to be shifted over the driver and truck drop pits. There is some difference of opinion regarding the advantages of the lean-to style of construction but it is undoubtedly a cheaper construction than if the trusses had been carried the full width of the house.

In but comparatively few instances have the reinforced concrete houses, which are now being quite generally used, followed the same section as the wooden frame roundhouses. Generally speaking, however, they have been of the monitor-type construction, varying principally in the number and spacing of the columns. For instance, Philadelphia & Reading has built a house of three-bay construction, two low bays on each side of a monitor section. The interior columns are all structural steel encased in concrete. The reason for adopting this type of column was to permit the installation of a jib crane. The roof is a combination floor tile, T-beam construction to form an insulating medium against temperature changes and condensation. All sashes are of steel with pivoted ventilating sections. As an aid in ventilation, five permanent slot openings were provided at the ceiling line between each set of columns in both sides of the monitor and through the back wall. In addition, of course, there is the smoke jack and the opening around it.

I believe the first instance where a bridge crane was installed in a roundhouse was that in one built by the Baldwin Locomotive Company at Philadelphia. This was built for repairing locomotives, and is equipped with two cranes, the larger of which is of 50 tons capacity. Among the first of the bridge crane types of houses built by a railroad was that of the Pennsylvania Railroad at Altoona, Pa. It was constructed in 1902 and consists of 52 stalls, handling an average of between 250 and 350 locomotives daily. The head room in the crane section is about 30 ft. and the crane capacity is 12½ tons It is interesting to note that an analysis of roundhouse crane requirements on the Pennsylvania Railroad made recently developed the fact that the maximum load that a crane would be required to handle was about 8½ tons. This meant that a 10-ton crane would be adequate for all purposes.

Another house along similar lines, and one which has been described quite frequently in technical journals, and railroad engineers' hand-books is that of the Western Maryland at Hagerstown, Md. This house is a steel frame construction, encased in concrete. Woven wire mesh was wrapped about the steel, and the concrete put in place by the Gunite system. The roof slab is 3-in. concrete with Hyrib reinforcing. It is of double monitor construction, permitting daylight to enter at three points in addition to the back wall. In connection with steel frame houses, I would call your attention to the fact that built-up columns, girders of heavy section, are being used as the frame in the new houses recently built by the Pittsburgh & Lake Erie. This company believes that if proper attention is given to the painting of these steel frames an unusually long life may be obtained from them.

The type of house recommended where repairs are light has a reinforced concrete frame with a column spacing that results in economical concrete beam construction. The roof slab is flat on the under side, and is formed with 8 in. by 24 in. floor tile, and 4 in. concrete T-beams. This provides an insulated roof and one which is just as cheap to construct as the plain slab. The location of the monitor windows is such that it will throw daylight into the working area. In addition, the sash area in the lean-to at the back of the house is large. Provision has been made for omitting one set of columns in the drop pit section. This is done to provide a clear floor area between the pits for removing wheels from the drop pits to the back of the house. Permanent openings 4 in. by 18 in. in section at the front and rear of the monitor and just below the roof slab will take off the gases which collect at those points.

So far as we can learn, the life of steel sash in a roundhouse is somewhat longer than of wooden sash in the same location, and it is just about as cheap. If it is kept well painted, steel sash has the additional advantage of not swelling under excessive moisture, and therefore the ventilators can be just as readily operated in the winter months as in the summer.

In houses where heavy repairs are made a crane of approximately 50 ft. span should be provided which, with a slight shifting of the locomotive, will reach any of the heavy repair parts which have to be handled. The height of the crane rail should be 26 ft. 6 in. above the floor line, which is sufficient to permit of the crane removing the cab without striking other parts of the locomotive. This height also greatly facilitates all crane movements. In a house with a craneway the objection may be raised that the crane installation does not permit the installation of the usual smoke jack. It has been found in houses of this section that the high monitor and the installation of a large ventilator or jack in the roof over each stall does not result in an objectionable accumulation of gases and smoke. In the winter time, and even in the summer, the fan in the hot blast heating system can be kept running to force out the gases.

I also want to call attention to the growing tendency to substitute the electric hoist for the truck and driver drop pit. In addition to reducing liability of accidents it removes wheels more quickly and cheaply. While this hoist is sometimes installed in the roundhouse, its proper location is in the back shop.

Serious objection to the drop pit has developed in recent years, owing to the extremely heavy locomotives and to the declining quality of roundhouse help. While accidents due to jacking up the locomotives for the removal of wheels do not occur frequently, there is always the liability, and it has greatly increased because of the failure to obtain intelligent labor.

Two types of roundhouse doors are quite generally used—a two-leaf steel-frame, wooden swinging door, and a rolling wood slat door. The former is the most popular because repairs are more readily made. The question is frequently raised whether or not it is desirable to provide sash in the door or in a transom over the door. Sash in the door permits lowering the roof level, but to some it is objectionable because the rough usage results in frequently broken glass. Daylight at the front of the house is not so essential, and all that is really needed may be had through small transom sash. On the other hand, it has been found that most of the blows which would break the glass in the door would break a wooden panel, and the glass is more readily replaced than the wood. For that reason, the glass area in the doors is made quite liberal in the roundhouses built by a number of roads.

Another tendency in roundhouse design and construction which has come into more general use in the past few years is the substitution of the hot blast heating system for the pipe coils or other forms of direct radiation. A hot blast heating system installation costs very little more than a direct system, and it has the additional advantage of providing forced ventilation in the house, which is often very necessary. At first the selection of too low fan and radiation capacity resulted in the indirect system being unsatisfactory. This has been corrected, and the fan may be speeded up in extremely cold weather to raise the temperature for thawing out frozen locomotives quickly.

TYPES OF VALVE GEAR ON FRENCH LOCOMOTIVES

BY W. G. LANDON

Various complicated arrangements of the Walschaert valve gear, all of which are in regular use on many French locomotives, are shown in the sketches. They are a further illustration of the difference between the French and American points of view and consequently the difficulty of making American equipment popular in France.

Fig. 1 shows a gear fitted to a large number of 4-4-0

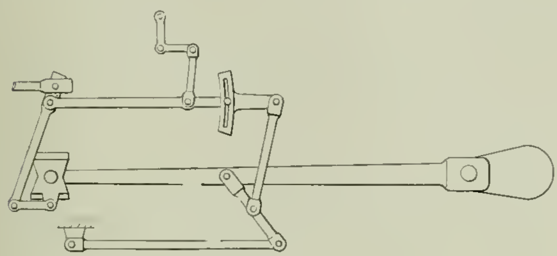


Fig. 1—Valve Gear as Applied to Etat 4-4-0 Type

engines built over twenty years ago for the Ouest (now Etat). It will be seen that a projecting arm from the link is actuated by a portion of the Joy gear. This gives a rapid valve travel at the beginning of the stroke, and the valve movement is perhaps more nearly theoretically correct

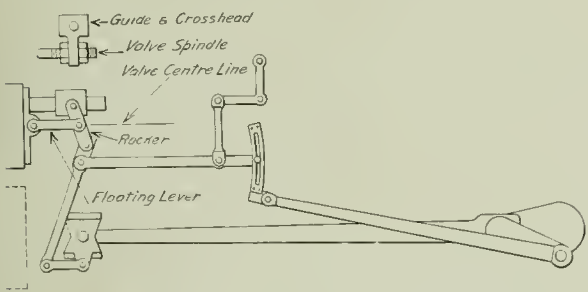


Fig. 2—Valve Gear as Applied to Etat 4-6-0 Type

than if the link were actuated by an eccentric. It would seem, however, that there are the disadvantages of the Joy gear (distortion from vertical movement of axle) plus a lot of extra parts. The driving wheels on this class of engine

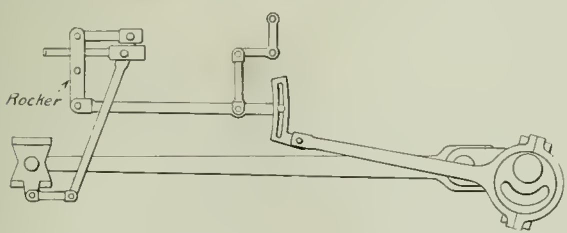


Fig. 3—Valve Gear as Applied to P. L. M. 4-6-0 Type

are equalized, but no trouble is experienced by valves getting out of square once they have been set for normal axle position.

Fig. 2 shows the evils of standardization. When a 4-6-0 superheater class engine was brought out on the Etat, the valve gear was made standard with that on the saturated engines, which have outside admission valves. The superheater engines have inside admission valves so a rocker arm was put in to make the gear distribute properly for inside admission. It will be seen that the thrust from the rocker is not in line with the valve center, and it is difficult to see anything but disadvantages either from a theoretical or practical standpoint. This arrangement is also used on the Nord.

Fig. 3 shows the valve gear on l.p. (inside) cylinders of

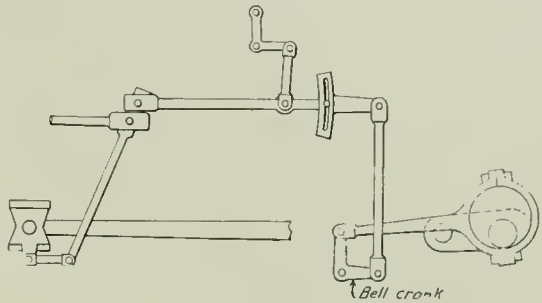


Fig. 4—Valve Gear as Applied to P. L. M. 4-8-0 Type

4-6-0 class on the Paris, Lyons & Meriterranean. The reason for the arrangement apparently was the fact that the links would not clear the bottom of the boiler. Other and simpler solutions of the problem would not, however, be hard to find.

Fig. 4 shows the gear on l.p. (inside) cylinders on 4-8-0 class, Paris, Lyons & Mediterranean. The object of this detour from eccentric to link the writer could not fathom.

PULVERIZED FUEL

At the annual convention of the International Railway Fuel Association held in Chicago, May 19-22, 1919, the Committee on Pulverized Fuel presented a progress report which consisted of the summary of some of the results obtained with pulverized coal with comments and suggestions. An abstract of the report follows:

Results obtained from tests brought out the following points: (a) A saving of 23 per cent in fuel could be made by burning pulverized coal. The main difficulties were the slagging over of the flue sheet and burning out of the brick arch. The slagging was largely overcome by an air jet to blow off the slag accumulations, but it was found impossible to overcome the rapid burning out of the brick arch. The cost of replacing the arch brick largely overcame the saving in fuel. The delay to locomotive was also a decided drawback.

"A comparison of costs of hand firing versus pulverized coal showed the hand firing to be most economical. It is thought possible to design a firebox that will eliminate such troubles as burning out of the brick arch and show an advantage in favor of the pulverized coal."

(b) "Burning 60 per cent anthracite and 40 per cent bituminous pulverized fuel gave all the steam that was wanted with splendid control.

(c) "The burning of pulverized coal in a locomotive was quite easy and satisfactory. The difficulties were with drying, pulverizing and handling the coal, and also the danger in connection with it. Locomotives equipped to burn pulverized coal would be tied up were the pulverizing plant to be burned or otherwise made inoperative."

One foreign railroad, the "Central Railway of Brazil," has made marked progress in burning pulverized coal. (See *Railway Age*, Oct. 26, 1917, page 767.)

Many pulverized fuel installations in stationary plants are reported as successfully burning various coals in pulverized form. A southwestern railroad reports: "Our stationary boiler plant that used pulverized fuel has been compelled to use a considerable amount of oil on acocunt of breakdowns and other troubles. We have had very little service on two boilers because of overhauling and remodeling of the fuel equipment. We kept the plant going on pulverized coal most of the time, but it has been a forced proposition."

The following conclusions may be deduced: The art of burning pulverized coal has shown marked progress; the experimental work has demonstrated the soundness of the principle of burning coal in a finely divided form in suspension, and that complete commercial success depends upon the careful working out of such details as proper fineness of the various grades of coals and economical and efficient methods and apparatus for preparing, storing and transporting the pulverized coal to the stationary plant or locomotive furnace. The tendency of explosion and spontaneous combustion should be eliminated entirely if possible to do so. The reabsorption of moisture will always be a problem in climates having extreme variations of temperature and humidity. It seems advisable to give more careful consideration to the steam locomotive as it exists today. A pulverizing and stoking device might be arranged that would prepare any grade of coal on the tender and deliver it to the firebox in the pulverized form, thus eliminating the expense of repairing and transporting pulverized coal from a central plant. Many of the universities have very thoroughly equipped laboratories that we are not using to a sufficient extent. It is suggested that in view of the immense supply of bituminous, lignite and other grades of coals adapted to the pulverized method of burning, the railroads, with the assistance of manufacturers and universities, make conclusive and exhaustive tests to develop the methods and apparatus necessary to meet the very urgent demands for more economical burning of coal.

The report was signed by W. J. Bohan (N. P.), chairman; H. T. Bentley (C. & N. W.), H. B. Brown (L. V.), R. R. Hibben (M., K. & T.), D. R. MacBain (N. Y. C.), J. H. Manning (D. & H.), H. C. Oviatt (N. Y., N. H. & H.), John Purcell (A., T. & S. F.), and L. R. Pyle (U. S. R. A.).

DISCUSSION

J. E. Muhlfeld (Pulverized Fuel Equipment Corporation) in a written discussion took issue with some of the statements in the committee's report. He asserted that the practicability of burning powdered coal had been established, and that it was necessary to develop it in order to increase the efficiency and capacity of the locomotive, to decrease the cost of fuel, to permit of using coal of poor quality and to eliminate smoke and soot. A. G. Kinyon (Fuller Engineering Company) submitted records of installations and reports of tests showing the high efficiency of boilers fired in this manner. Several speakers called attention to the fact that troubles similar to those experienced with pulverized fuel had been encountered in the period of development of practically all the accessories used on locomotives. M. C. M. Hatch (Pulverized Fuel Equipment Corporation) expressed the opinion that the crux of the matter lay in the design of a locomotive furnace. Large furnace volume is needed for burning pulverized fuel and no locomotive has yet been built with the proper design of furnace for this fuel. Where proper care is taken in designing the furnace, stationary installations are uniformly successful.

The association decided to ask the co-operation of Purdue University, the University of Illinois and the Bureau of Mines to solve the problem of burning pulverized coal.

LOCOMOTIVE FUEL LOSSES AT TERMINALS*

BY J. M. NICHOLSON
Fuel Supervisor, Atchison, Topeka & Santa Fe

The fuel consumed by locomotives while in terminals is an incident of operation which requires a variable amount of fuel and has been given too little consideration for the quantity involved. The engineer and fireman, who are with the locomotive while from 75 to 90 per cent of the fuel is burned, have been charged with being very wasteful. The remaining 10 to 25 per cent is burned at the terminal in getting the locomotive ready for service and taking it to the enginehouse, much of which is the result of wasteful methods and practices.

Locomotives must be moved from yards to cinder pits, have the fires knocked, and be put in the house in order that necessary repairs can be made. They must be fired up and tests of locomotive auxiliary appliances properly made, after which they must be moved from the roundhouse to the train. These essential activities of operation require the use of fuel, but the fuel used in addition to that required for these purposes must be considered as waste.

When a locomotive is brought to a terminal the fire should be burned down to such a point that it will not be necessary to rebuild the fire in order to get the water level in the boiler to the proper height before knocking the fire. The dampers on oil burning locomotives and also coal burning locomotives, so equipped, should be closed as soon as the work at the cinder pit is completed and the blower shut off to reduce circulation of air through the boiler.

The roundhouse capacity should be such that no delay will be caused in getting the locomotive into the house. When a locomotive reaches the house a competent inspector should enter the firebox and see that the flues are clean and free from leaks. The arches must be clean and in repair. The grates must be thoroughly cleaned, and grates having broken fingers or excessive openings repaired or removed. The ash pans must be thoroughly cleaned and special attention given to see that the air opening under the mudring is cleaned. The front end should be inspected to see that it is self-cleaning and that it is free from air leaks.

As soon as the boiler and grate work is completed the grates should be bedded down with from three to four inches of coal evenly distributed over the entire grate area. The coal which falls through while bedding down the grates should be reclaimed. Tests show the coal reclaimed will vary from 80 to 200 lb. per locomotive, depending on the size of coal used and the amount of surface moisture on the coal. The coal can be reclaimed by collecting it in a bag fastened to the ash pan slide and removing the bag as soon as the grates are bedded down, or at larger terminals a pit on the outgoing track can be used for dumping this coal and conveying it into the car. A terminal handling 50 locomotives per day will conserve from 50 to 100 tons per month by reclaiming this coal.

In case the boiler is to be washed, the heat in the boiler is entirely wasted unless the roundhouse is equipped with a hot water boiler wash-out system. A plant of sufficient capacity, if properly maintained and operated, will reduce the time consumed in the operations of washing the boiler from 25 to 50 per cent and reduce the amount of fuel used in firing up from 25 to 30 per cent. The saving of from two to three hours' time in getting the locomotive back in service

*Abstract of a paper presented before the International Railway Fuel Association convention at Chicago, May 19-22, 1919.

is an important factor under present operating conditions, as is also the saving of from 600 to 700 lb. of coal per locomotive.

In many cases where boilers are not due to be washed out engines are allowed to stand in the roundhouse twelve to fifteen hours before the time set for the locomotive to leave the roundhouse. During this time the heat in the boiler has been passed out through the stack unless a stack cover is used or the dampers closed to prevent circulation of air through the boiler. This heat waste can be found in practically every roundhouse, and results in several tons of coal per locomotive being wasted each month. The time required to furnish a locomotive is greatly influenced by the pressure maintained in the roundhouse blower steam line. Insufficient pressure results in the use of more coal in firing up a locomotive and decreases operating efficiency. The use of old ties, old car material, shavings, etc., will reduce the amount of coal consumed and should be used where practical.

The chief despatcher should furnish the roundhouse foreman with a list of trains that he expects to run and the roundhouse foreman should furnish the despatcher with a list of locomotives he expects to have ready. The exchange of these lists three times in twenty-four hours is advisable, after which the locomotives should be ordered for a scheduled leaving time, giving the roundhouse the necessary time to fire up the locomotive and call the engine crew. This will avoid holding locomotives under steam in cases where trains are set back or cannot be run according to the line-up. In cases where locomotives are fired up as soon as the work is completed and allowed to stand under steam for seven hours, the fuel wasted is equal to the amount of fuel that is necessary to furnish the locomotive for service. This is not an uncommon occurrence where despatching schedules are not in effect and where they are not given close supervision.

The wages paid for one hour's terminal delay on a freight train is a loss equivalent to the cost of one ton of coal, also eight locomotive hours under steam in addition to the time actually necessary to get the locomotive ready for service is a loss equal to the value of a ton of coal. Every locomotive on a division is burning some fuel at the terminals that is unnecessary, and many locomotives are burning before each trip fuel of greater value than the loss of wages paid for one hour's terminal delay. If this loss were given as close supervision as is given the wages paid for terminal delay, the cost of transportation would be reduced. Superintendents should know personally that locomotives are not being held under steam unnecessarily on their division and also that co-operation in the despatching of locomotives does exist.

The fuel that is consumed as a result of lack of facilities for handling is a costly proposition, and adequate roundhouse and shop facilities should be provided. Repairs to turntables, roundhouses, coal chutes and tracks at the terminal should be made before cold weather sets in, as it may result in congested single track movement at coal chutes and cinder pits or tie up the entire roundhouse, all of which wastes fuel. Proper care of a fire in the roundhouse contributes to economic locomotive performance on the road and also reduces the amount of fuel used at the terminal. The locomotive appliances should be tested out before leaving the roundhouse for the train to see that they are in the best possible condition to do their work, which means a saving of fuel on the road that, in most cases, cannot be accomplished after leaving the terminal. The train line leakage should be determined and the leaks repaired at the terminal. Train line air leaks cost a railroad company much more than it costs to repair them.

Locomotives should be maintained to prevent serious steam, air and water leaks. Throttles leaking, pops leaking and air pumps running in the house are to be avoided. All of the operations at a roundhouse contribute to fuel economy, and men should be impressed with the fact that neglect on their part often results in a waste of fuel greater than their day's wages before the locomotive reaches the next terminal where proper repairs can be made.

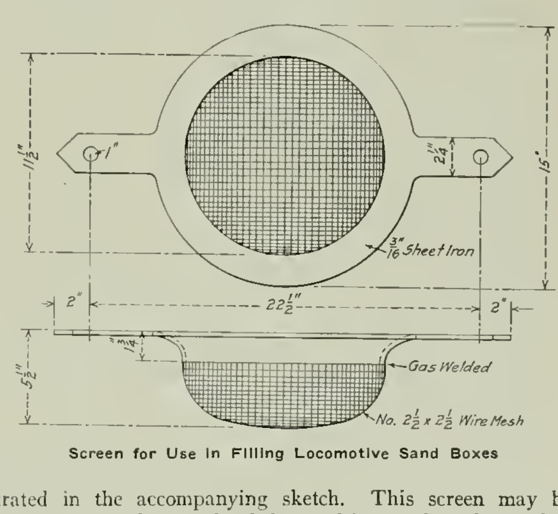
The amount of coal required for the period of firing up a locomotive and getting it ready for service under careful handling should be determined. The actual consumption against the required consumption is the fuel efficiency of the despatchers and the roundhouse organization. This efficiency is not a maximum, even on the best managed and best equipped roads. The magnitude of the amount of fuel involved in these losses should provide a strong incentive to renewed effort in fuel conservation as these conditions of fuel waste are decreasing operating efficiency and increasing the cost of transportation.

A LOCOMOTIVE SAND BOX SCREEN

BY A. P. JANDER
General Foreman, A. T. & S. F., Hutchinson, Kans.

A source of great annoyance in the roundhouse and on the road is the stoppage of the pipes and traps of the locomotive sanding apparatus. A properly working sanding apparatus is especially to be desired in bad weather as great harm is often done to an engine through the failure of the sanding equipment to work properly at a critical time, and in addition the delays occasioned by the failure of this apparatus frequently have serious results.

In drying and screening sand at the sand house all foreign matter is not always removed and this getting into the sand box eventually chokes the sand pipe so that the apparatus will not operate in a satisfactory manner. To overcome this trouble the writer has designed a sand box screen as illustrated in the accompanying sketch. This screen may be adjusted over the mouth of the sand box and as the sand is poured in, the screen is turned slightly, thus permitting the clean, fine sand to enter the box, but excluding all stones and foreign matter. Two of these screens kept in a convenient place, one on each side of the sandhouse, so that they may be used when filling the sand boxes of locomotives, will eliminate a great deal of the trouble experienced on the road. The expense of making the screens and the time required for their operation is so small that it need not be considered. An engine can be as easily and as quickly sanded with these screens as without them and if made of proper material, they are practically indestructible.



Screen for Use in Filling Locomotive Sand Boxes

RAILROAD ADMINISTRATION NEWS

Enlargement of the Board of Railroad Wages and Working Conditions from six to twelve members is under consideration. Such an enlargement has been proposed by the labor board. It is proposed to add a representative of the engineers, clerks and maintenance of way employees and three more officials.

A NATIONAL "DRIVE" FOR SAFETY

Walker D. Hines, director general of railroads, announces that a "National Railroad Accident Prevention Drive" will be started on October 18 at 12:01 a. m. and will be continued until October 31 at midnight, to be conducted under the supervision of the Safety Section. A circular, sent to the regional directors, calls for their co-operation. All officers and employees are expected to give their hearty support.

This drive follows the very satisfactory results of certain "no accident campaigns" already carried out. The results of these campaigns are summarized as follows:

Region	Total No. of employees	Casualties, 1919	Casualties, 1918
Southern, January 19-25	230,000	77	466
Southwestern. May 1-31	174,884	646	1,475
Central Western, June 22-29	327,000	100	456
Northwestern June 22-29	274,224	119	481

In the Southern region 28 out of 45 railroads reported no accidents; in the Southwestern region 12 roads were in this class, in the Central Western 47 out of 67 and in the Northwestern 50 out of 63, showed clear records.

FIREMEN DEMAND MECHANICAL STOKERS AND WAGE INCREASE

In order to meet the high cost of living the Brotherhood of Locomotive Firemen and Enginemen has decided that its members must have not only a large increase in wages, estimated at 35 to 65 per cent, but also the assistance of mechanical stokers on engines weighing over 200,000 lb., mechanical coal passers on locomotives of less weight, and power grate shakers and fire door openers on all locomotives.

The demands are as follows: Firemen and helpers in passenger service, $6.50 a day of 5 hours or less, 100 miles or less (Mallet locomotives, $7.20); through freight service on locomotives weighing less than 200,000 lb., $6.50 a day for 8 hours or less, 100 miles or less, on locomotives weighing over 200,000 lb., $6.80; local or way freight service, mixed trains, mine runs, etc., minimum of 50 cents per 100 miles or less in addition to through freight rates; helper, pusher, transfer, work, wreck, construction, snow plow, circus, milk and unclassified service, through freight rates; yard service, $6.50 (Mallet $6.80), on Mallet locomotives in all except yard service, $7.20 a day; inside hostlers, $6.80 a day; outside hostlers, $7.20; hostler's helpers, $6.50, eight hours or less; all coal burning locomotives to be equipped with power grate shakers and automatic fire door openers. All coal-burning locomotives in road service weighing over 200,000 lb., to be equipped with mechanical stokers and two firemen to be employed on each engine until so equipped. All locomotives weighing less than 200,000 lb. to be equipped with coal passers. Firemen to be relieved of cleaning locomotives, removing tools or supplies, loading coal, filling lubricators, etc.

ROADS CO-OPERATE WITH VOCATIONAL EDUCATION BOARD

W. T. Tyler, director of the Division of Operation, and W. S. Carter, director of the Division of Labor, have issued the following joint circular authorizing co-operation by the railroads in the establishment of part-time schools for railroad apprentices and others:

"The Federal Government has created under the provisions of an act of Congress, approved February 23, 1917, a Federal Board for Vocational Education.

"The purpose of this act is to provide for the promotion of vocational education in the trades and industries and in agriculture in co-operation with the various states, and an appropriation by the Federal Government is available for such work.

"The value of vocational training for mechanics and apprentices in railroad shops has been recognized by many railroads which have established schools for the training of such men. It is the desire of the Railroad Administration not only to assist and encourage such training where established, but also to extend the system to roads which have not established such schools, and it is believed that this can be best accomplished by co-operation between the United States Railroad Administration and the Federal Board for Vocational Education in extending this work.

"It is therefore desired that the different railroads under control of the United States Railroad Administration co-operate with the Federal Board for Vocational Education in the establishment of part-time schools for railroad shop apprentices and others who come within the scope of the act. Where it is found necessary in order to facilitate this work, railroads will be authorized on request, to fit up suitable study or class rooms at the different shops where such schools may be held. Where such schools are established, railroads will be authorized to pay apprentices at their usual rate for the time spent in attending such schools.

"Apprentices on roads where such schools are established will be required to attend not less than 208 hours per year.

"Complete information concerning the establishment of these schools in co-operation with the Federal Board for Vocational Education may be obtained either from the board direct or from the assistant director, Division of Operation, in charge of the Mechanical Department.

"In the preparation of a course of study, due attention must be given to meet the needs of railway shop employees, and such subjects as shop practice involving the manipulation of machines used in general repair and construction work and to related science, mathematics and drawings should be fully provided for.

"To provide uniformity as far as practicable in these courses of study, the subjects embraced therein should be submitted to the assistant director, Division of Operation, in charge of the Mechanical Department, for approval."

ORDERS OF REGIONAL DIRECTORS

Safety Chains on End Doors.—Order 227 of the Southwestern regional director promulgates a note from the Safety Section of the Railroad Administration recommending that chains or some other suitable device be applied on automobile cars with end doors to prevent these doors from opening further outward than the line of the side of the car; and gives instructions to have cars in this region so equipped as rapidly as possible.

Freight Car Distribution—Circular 27.—The Southwestern regional director in Circular 234 states that the provisions of Division of Operation Circular 27 with respect to returning cars to owners for repairs appear to have been more broadly construed than was intended. Cars have been sent long distances home for comparatively light repairs. The purpose of this circular was to put into effect former M. C. B. requirements for the return of cars to owning lines for repairs and in addition the circular was intended to provide a means for the owners to get their cars home when desired for rebuilding or for the application of betterments. It was not desired that the cars should be sent home involving an intermediate line haul except for "rebuilding or for the application of betterments" as provided in paragraph C of the circular, in which case arrangements should be made for this movement in accordance with paragraph 6.

STEAM HOSE FOR CAR HEATING*

BY H. J. FORCE

The object of this paper is to describe briefly a process of manufacture of steam hose for car heating which will neither contract nor expand when in service.

TABLE I—DESCRIPTION OF MANUFACTURE OF FOUR KINDS OF STEAM HOSE

Serial	Tube	Thickness, in.	Duck	Friction	First ply of gum to anchor braiding	First ply braiding	Second ply of gum to anchor braiding	Second ply braiding	Outside cover
P......	Special steam resisting hose.	1/8	2 ply, not under 23 oz. per sq. yd.	Heavy coated special steam resisting.	1/16 in. thick, special steam resisting.	No. 8/3 yarn in 5 by 5 strands.	1/32 in. thick, special steam resisting.	No. 8/3 yarn in 5 by 5 strands.	1/32 in. special steam resisting.
Q......	Regular specification steam hose.	1/8	Same as P.	Heavy coated regular specification steam resisting.	1/16 in. thick, regular specification steam resisting.	Same as P.	1/32 in. thick, regular specification steam resisting.	Same as P.	1/32 in. regular specification steam resisting.
R......	Regular specification steam hose.	5/32	Same as P.	Same as Q.	Same as Q.	Same as P.	Same as Q.	Same as P.	Same as Q.
S......	Regular specification steam hose.	5/32	3 ply, not under 23 oz. per sq. yd.	Same as Q.	Same as Q.	Same as P.	Same as Q.	Same as P.	Same as Q.

When made from duck alone, steam hose has been found to contract to such an extent in service that in some cases it becomes uncoupled when passing around a short curve.

TABLE II—TESTS OF HOSE, SERIAL P

All Hose Steamed to Bursting 10 Hours a Day at 60 Lb. Pressure

Sample No.		1	2
Inside diameter, in.	Before steaming..	1.625	...
	After steaming...	1.75	1.69
Outside diameter, in.	Before steaming..	2.625	...
	After steaming...	2.75	2.69
Thickness, in.	Before steaming..	0.125	...
	After steaming...	0.213	0.230
Number of plies		2	2
Friction, in.	Before steaming..	4.125	...
	After steaming...	3.0	4.0
Stretch of cover, in.	Before steaming..	7.5	...
	After steaming...	5.0	5.5
Stretch of tube, in.	Before steaming..	8.5	...
	After steaming...	5.0	5.0
Deflection, in.	Before steaming..	2	2.0
	After steaming...	2.75	1.25
Tensile strength of tube, lb. per sq. in.	Before steaming..	600	...
	After steaming...	70	65
Time required to burst under 60 lb., hours	Before steaming..	...	...
	After steaming...	525	840

Again, the failure of steam hose in many cases has been traced directly to the excessive expansion which takes place after the hose has been in service for some time. This expansion frequently results in the hose blowing off from the coupling, requiring the use of a special clamp to hold the hose on the coupling.

After making a series of tests, it was decided to build a hose of duck with a heavy friction, and then one or more layers of braiding. If made from duck alone, hose will expand excessively. It is impracticable to make it from braiding alone, but with a combination of duck and braiding a very satisfactory grade of steam hose can be produced which will show no contraction in length and no expansion in diameter under the most severe service conditions.

Table I gives a general description of the process of manufacture of four hose designated as Serials P, Q, R and S.

In Table II are given results of tests to destruction of two samples of steam hose of Serial P. In this hose a special steam-resisting compound was used for the inner tube which was not looked upon favorably by the manufacturer.

In Table III are given the results of tests on ten samples of hose of Serial Q. This hose is similar to that of Serial P except that the regular specification tube was used which had been found to give fairly satisfactory results in service. Aside from this Serials P and Q are of the same composition. The samples of Serial Q, after steaming, withstood a pressure of 60 lb. for about 700 hours, on the average, before bursting.

In the hose of Serial R, the manufacturer endeavored to

*A paper presented before the convention of the American Society for Testing Materials at Atlantic City, June 24-27, 1919.

TABLE III—TESTS OF HOSE, SERIAL Q

All Hose Steamed to Bursting 10 Hours a Day at 60-lb. Pressure

Sample No.		1	2	3	4	5	6	7	8	9	10
Inside diameter, in.	Before steaming...	1.625	....	....	....	....	....	....	....	....	....
	After steaming....	1.72	1.69	1.69	1.69	1.562	1.69	1.69	1.75	1.625	1.75
Outside diameter, in.	Before steaming...	2.5	....	....	....	....	....	....	....	....	....
	After steaming....	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Thickness, in.	Before steaming...	0.125	....	....	....	....	....	....	....	....	....
	After steaming....	0.113	0.160	0.160	0.167	0.169	0.155	0.16	0.163	0.170	0.171
Number of plies		2	2	2	2	2	2	2	2	2	2
Friction, in.	Before steaming...	0.25	....	....	...	....	....	....	....	....	....
	After steaming....	1.5	7.0	4.0	1.5	1.25	6.0	8.0	6.0	3.0	4.0
Stretch of cover, in.	Before steaming...	7.25	....	....	...	....	....	....	....	....	....
	After steaming....	2.5	4.0	3.5	4.0	3.0	3.0	3.0	4.0	3.0	3.5
Stretch of tube, in.	Before steaming...	7.0	....	....	....	....	....	....	....	....	....
	After steaming....	5.75	3.5	3.0	5.0	6.0	3.0	3.5	4.0	3.5	3.5
Deflection, in.	Before steaming...	3.0	2.75	2.75	2.875	2.875	2.5	2.75	2.5	2.5	2.625
	After steaming....	2.0	2.0	1.75	2.0	1.25	1.25	1.375	2.0	1.75	2.0
Tensile strength of tube, lb. per sq. in.	Before steaming...	570	....	....	....	....	....	....	....	....	....
	After steaming....	336	118	125	113	106	111	106	110	111	119
Time required to burst under 60 lb., hours.	Before steaming...	615	....	....	....	....	....	....	....	....	....
	After steaming....	60*	555	690	700*	700*	775	785	753	693	693

*Test samples removed before bursting.

increase the thickness of the inner tube. Results of tests of this hose are given in Table IV. In some of the lengths of hose tested after steaming, there was an apparent increase in thickness over that of the measured sample, as compared with Serials P and Q, although these too vary considerably showing that the tubes in many cases were undoubtedly not uniform in thickness, at least at various places in the tube. The results of tests on steaming were practically the same as those in Serials P and Q.

TABLE IV—TESTS OF HOSE, SERIAL R

All Hose Steamed to Bursting 10 Hours a Day at 60-lb. Pressure

Sample No.		1	2	3	4	5	6	7	8	9	10
Inside diameter, in.	Before steaming	1.625	....	....	....	....	....	....	....	....	....
	After steaming	1.72	1.69	1.75	1.812	1.69	1.75	1.625	1.75	1.75	1.75
Outside diameter, in.	Before steaming	2.50	....	....	....	....	....	....	....	....	....
	After steaming	2.53	2.562	2.50	2.562	2.50	2.50	2.562	2.50	2.50	2.50
Thickness, in.	Before steaming	0.125	....	....	....	....	....	....	....	....	....
	After steaming	0.134	0.154	0.151	0.153	0.165	0.170	0.180	0.168	0.200	0.175
Number of plies		2	2	2	2	2	2	2	2	2	2
Friction, in.	Before steaming	0.625	....	....	....	....	....	....	....	....	....
	After steaming	0.625	1.75	4.0	7.0	1.875	4.0	6.0	4.0	7.0	7.0
Stretch of cover, in.	Before steaming	7.75	....	....	....	....	....	....	....	....	....
	After steaming	3.5	3.0	4.0	6.0	4.0	4.0	3.0	3.0	4.0	6.0
Stretch of tube, in.	Before steaming	5.5	....	....	....	....	....	....	....	....	....
	After steaming	5.5	4.75	3.50	4.0	5.125	4.0	4.0	4.5	4.0	3.0
Deflection, in.	Before steaming	2.0	2.625	2.75	2.125	2.75	2.25	3.0	2.75	2.375	2.875
	After steaming	2.25	1.50	1.50	2.0	2.0	1.25	1.0	2.50	1.50	1.875
Tensile strength of tube, lb. per sq. in.	Before steaming	511	....	....	....	....	....	....	....	....	....
	After steaming	313	137	130	124	115	106	94	143	90	114
Time required to burst under 60 lb., hours.	Before steaming	700	....	....	....	....	....	....	....	....	....
	After steaming	60*	700*	519	530	700*	625	754	680	793	525

*Test samples removed before bursting.

In the hose of Serial S the number of plies of duck was increased from two to three, and this apparently had the effect of nearly doubling the life of the hose. It will be noted from Table V that samples Nos. 5 and 6 of this hose burst under 60 lb. pressure, after steaming, in 770 and 800 hours respectively, and that samples Nos. 8 and 10 withstood this pressure about the same number of hours; while samples Nos. 4 and 9 stood up for approximately 1500 hours. A careful investigation of the inner tube revealed the fact that several of these samples were defective. Pieces of wood were found embedded in the inner tube which measured ¼ in. wide, ⅛ in. thick by ½ in. long. The addition of this foreign matter to the rubber compound without a question of doubt caused the failure of samples Nos. 5, 6, 8 and 10, and this is primarily due to the use of machine-made tubes.

TABLE V—TESTS OF HOSE, SERIAL S

All Hose Steamed to Bursting 10 Hours a Day at 60-lb. Pressure

Sample No.		1	2	3	4	5	6	7	8	9	10
Inside diameter, in.	Before steaming	1.625	....	....	....	....	....	....	....	....	....
	After steaming	1.72	1.562	1.625	1.69	1.75	1.625	....	1.562	1.562	1.69
Outside diameter, in.	Before steaming	2.625	....	....	....	....	....	....	....	....	....
	After steaming	2.69	2.625	2.625	2.69	2.625	2.625	....	2.69	2.69	2.625
Thickness, in.	Before steaming	0.125	....	....	....	....	....	....	....	....	....
	After steaming	0.129	0.160	0.167	0.200	0.200	0.192	....	0.195	0.195	0.156
Number of plies		3	3	3	3	3	3	3	3	3	3
Friction, in.	Before steaming	1.0	....	....	....	....	....	....	....	....	....
	After steaming	2.75	6.25	8.0	8.0	7.0	2.0	....	2.5	8.0	3.0
Stretch of cover, in.	Before steaming	7.25	....	....	....	....	....	....	....	....	....
	After steaming	4.0	3.0	6.0	3.5	3.0	5.0	....	2.5	3.5	3.0
Stretch of tube, in.	Before steaming	5.25	....	....	....	....	....	....	....	....	....
	After steaming	5.0	4.5	6.0	3.0	4.0	4.0	....	4.0	3.5	4.0
Deflection, in.	Before steaming	2.50	2.0	2.0	2.5	1.75	1.75	2.0	1.625	1.75	1.50
	After steaming	1.25	1.50	1.0	1.25	0.75	0.875	....	0.625	1.0	1.0
Tensile strength of tube, lb. per sq. in.	Before steaming	520	....	....	....	....	....	....	....	....	....
	After steaming	325	125	132	80	105	94	....	103	177	141
Time required to burst under 60 lb., hours.	Before steaming	700	....	....	....	....	....	....	....	....	....
	After steaming	60*	700*	700*	1477	770	800	....	830	1535	862

*Test samples removed before bursting.

It is recommended that in all steam hose or in any hose that is subjected to considerable temperature, a calendered-made tube composed of three distinct layers should be used. This will very materially reduce the chances of dirt or foreign matter getting mixed with the rubber compound, and should a small amount be present the other two calenders will undoubtedly preserve the life of the hose.

This investigation shows:

1. That steam hose should be made of a composition of duck and braid.

2. That machine-made tubes should not be used, and that tubing of three-ply calender should in every case be used in hose which is to be subjected to any considerable degree of temperature.

COLOR OF LOCOMOTIVES.—"Speaking of Chinese railroads reminds me of the failure of an American manufacturer to obtain a contract for locomotives because his European competitors made a more careful study of Chinese peculiarities," writes Lynn W. Meekins in the Scientific American. "One locomotive was ordered from each of the competing companies. In every respect save one the American product was unmistakably superior. However, it had been painted black before shipment from the works, and on the way across the Pacific it became more or less rusted. Its appearance, therefore, was far less attractive than that of the European locomotives, which were painted in accordance with Chinese preference, and had been touched up by the manufacturers' agents after arriving in China. Don't get your colors mixed if you want to sell goods to the Chinese."

PRICES AND PRODUCTION.—"Far more wealth is probably lost through restricted output than is claimed in increased wages," say the Times, London. "It is not certain at present how far the industries concerned can pay the advances of wages that are or will shortly be asked, but what is very certain is that these advances, if they are paid, will have to come mainly from increased production, the promotion of which is therefore of more use to workers than even the immediate grant of increased pay. What all parties to industry will be compelled by inevitable circumstances to realize is that no source exists to pay advanced wages or even to maintain employment except actual production."

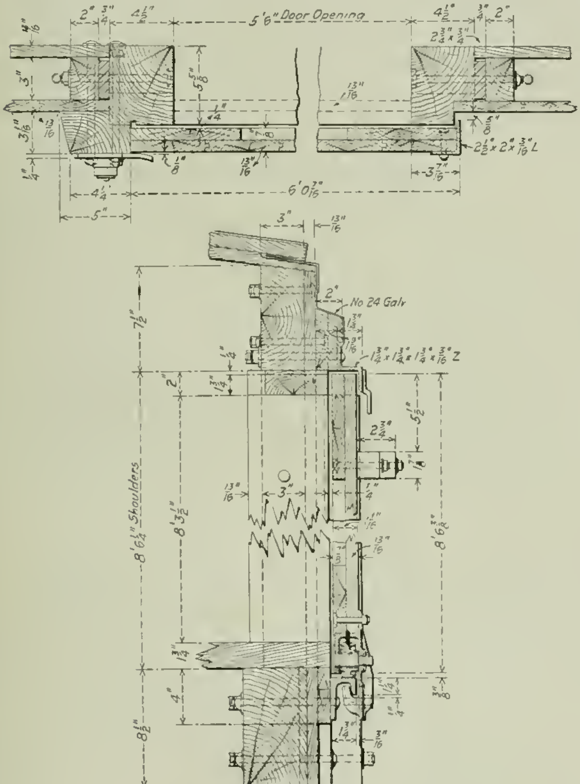
Box Cars Built by C. M. & St. P.

Underframe Has Steel Center Sill and Wooden Side Sills; Wooden Frame Body with Steel Ends

A 40-TON box car in which many interesting features have been incorporated has been designed by the Chicago, Milwaukee & St. Paul, and a lot of 1,000 is now being built in the company's shops at Milwaukee. The general outside dimensions of the car are as follows: length 42 ft. 1½ in.; height at eaves 13 ft. 2 in. and width at eaves 9 ft. 11 in. The inside of the body is 41 ft. 5½ in. long, 8 ft. 10⅜ in. wide, 9 ft. 1⅞ in. high at the center and 8 ft. 8⅝ in. high at the sides with a door opening 8 ft. 2¼ in. high. The cubical capacity of the car is 3,267 cu. ft.

UNDERFRAME

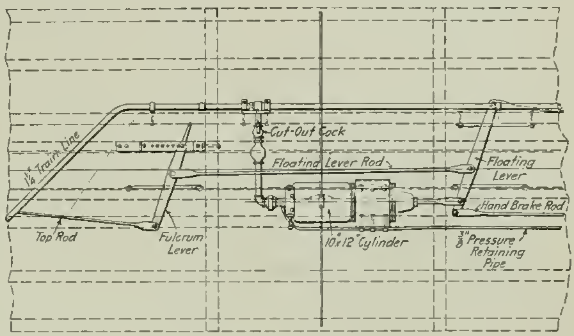
The underframe is made up of a steel center sill with three wooden sills and three truss rods on each side. The center



Details of the Door Construction

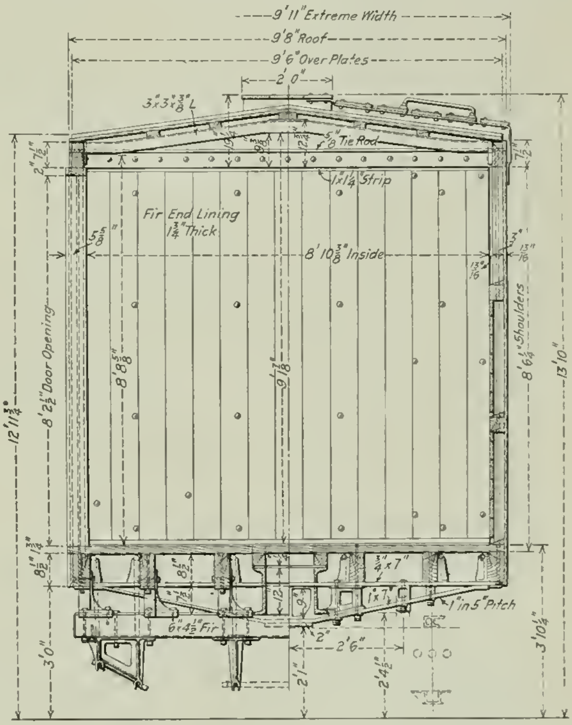
sill consists of two 12-in. 40-lb. channels 43 ft. long with a ¼-in. by 20-in. cover plate extending practically the full length on top of the sill. A double body bolster of the built-up type is used. The top chord members are ¾ in. by 7 in. and pass through the center sill channels near the neutral axis and over a combined filler and center plate casting. The bottom bolster members are 1 in. by 7 in. and pass under the center casting. Malleable iron fillers are bolted between the two members at each intermediate sill and also at the side bearings.

The end sill is of wood, 6½ in. wide by 8½ in. high. It is cut out to a height of 3¾ in. where it passes over the center sill. Two nailing strips 3¾ in. high are bolted along each side of the center sill. With the four intermediate and two side sills, there are eight points of support for the floor boards.



Foundation Brake Arrangement of the C. M. & St. P. Box Car

The sills are all 8½ in. high, the width of the intermediate sills being 4 in. and of the side sills 4½ in. The truss rods are 1¼ in. in diameter, with ends upset to 1½ in. The needle

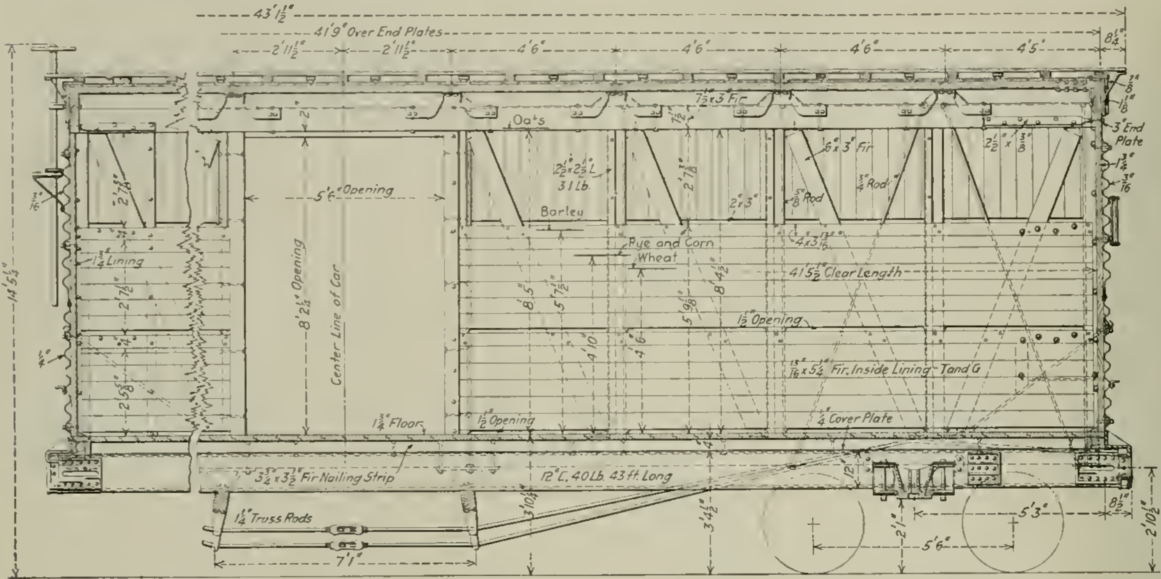


Half Sections of the C. M. & St. P. Double Sheathed Box Car

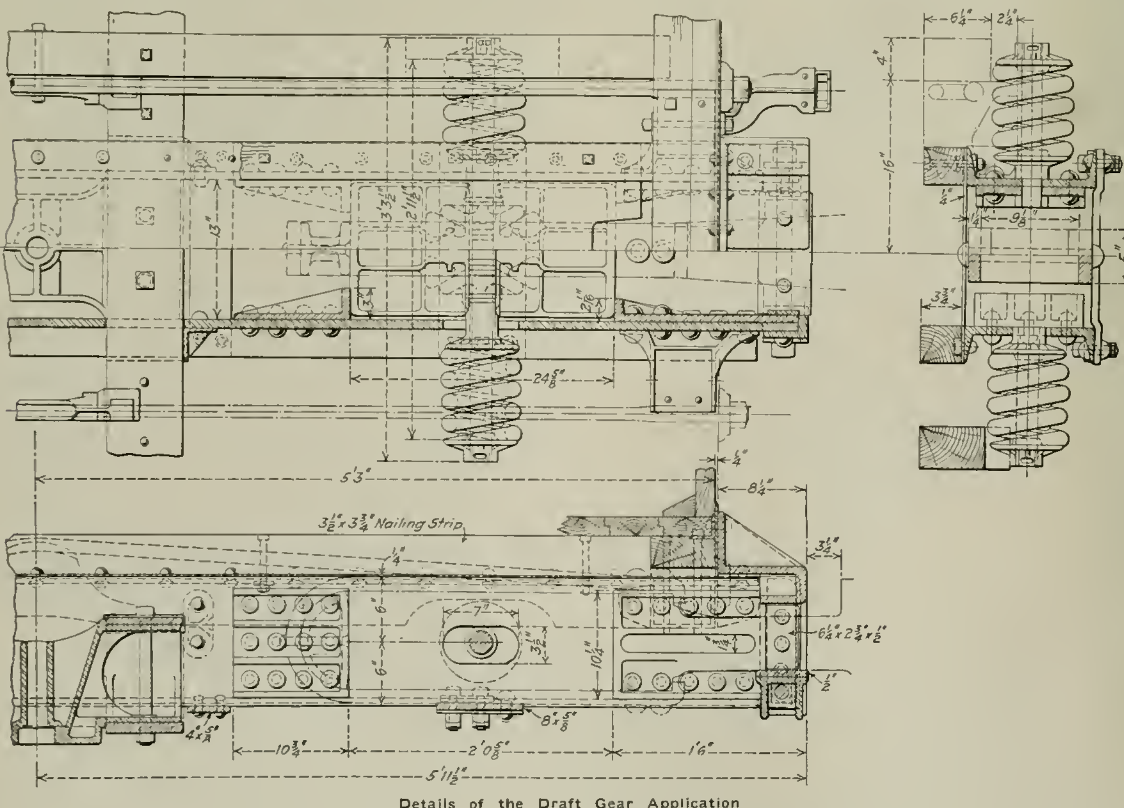
beams are secured to substantial spacing castings attached to the bottom of the sills.

The draft gear is of the Cardwell friction type. One of the illustrations shows the details of the application. A coupler with a 5-in. by 7-in. shank is used, but slots for a coupler key are provided in the sills.

The side trusses are made up of 6-in. by 3-in. posts and braces, each vertical post being reinforced by a 2½-in. by 2½-in. angle iron, weighing 3.1 lb. per ft. The door posts are made up of a 4½-in. by 5⅝-in. and a 2-in. by 3-in. post with a 2¾-in. by ¾-in. wrought iron strip between. These parts are bolted together and the front door post is further reinforced by the door stop. The side plate is 7½-in. by 3-in. There are two belt rails 4 in. by 3 13/16 in. located 2 ft. 5⅝ in. and 5 ft. 5⅛ in. from the floor. The flooring is 1¾ in. thick, the inner and outer sheathing are 13/16 in.



Longitudinal Section Showing the Arrangement of the Body Framing



Details of the Draft Gear Application

The ends are of the Murphy two-piece type, ¼-in. plates being used for the lower section and 3/16-in. plates for the upper. The lower plate extends down behind the striking casting and over the end sill and a 2½-in. by 2½-in. angle iron riveted to the plate sets into the upper face of the sill. This construction is clearly shown in the drawing of the draft rigging. Diagonal braces extend from the post pocket casting over the bolster to the top of the lower end section on each side. The end plate, to which the upper section is joined, is 3 in. thick and is fastened to the side plate with strap bolts. The end is lined with 1¾-in. matched boards placed vertically.

The roof is supported on Ideal carlines formed of two 3-in. by 3-in. by ⅜-in. angles, to which are bolted the wooden purlines and ridge pole. The roof is the Murphy type XLA flexible. The doors are of the bottom supported type with Camel door fixtures. Details of the construction at the doors are shown in one of the illustrations.

BRAKE SLACK ADJUSTER

An interesting detail of the brake rigging is the method employed for taking up the slack. No adjustment is provided in the bottom or top rods. Instead, the fulcrum lever is attached to a bracket which has several holes for adjusting the piston travel. The lever is provided with a handle and lettering on the side of the car calls attention to the fact that excessive travel is to be taken up at the fulcrum lever and not at the trucks. The convenience of this arrangement has proved of great assistance in eliminating excessive piston travel.

Maintenance of Freight Brakes

Summary of the Instructions to be Published for Distribution by the Air Brake Association

At the convention of the Air Brake Association held in Chicago May 6 to 9, 1919, a comprehensive set of instructions was presented to the association by Mark Purcell as a part of his paper on that subject. In the abstract of Mr. Purcell's paper, published in the *Railway Mechanical Engineer* for June, 1919, page 301, these instructions were not referred to in detail, and a summary of those of the greatest importance is here given.

The instructions outline the practice to be followed in cleaning and repairing air brake equipment on freight cars, and the association finally adopted them as recommended practice, to be published in pamphlet form for sale by the association, with the intention that they be distributed generally to air brake repairmen, foremen and others interested. Before final action to this effect was taken a spirited discussion took place on a number of the author's recommendations, which led to the appointment of a committee, including Mr. Purcell, to agree upon the proper instructions on the points in controversy, which were presented to the association for adoption.

GENERAL INSTRUCTIONS

The instructions specify that freight car brakes are to be cleaned on all repair and shop tracks that are equipped with air pressure for brake testing, and that they will not be cleaned at points where air pressure is not available. All cars marked for bad order triple valves or brake cylinders, or where brakes either will not apply or leak off, are to receive the same treatment as that required for brakes which are out of date. Repairs are to be made, whether their brakes are in date or out of date, on all cars with loose or missing pipe clamps, angle cocks or hose turned out of standard position, loose brake cylinders, auxiliary reservoirs and their supporting brackets, brake rods worn by contact with wheels or axles, and angle cocks which are non-standard in position.

Cars with brakes in date, that is, with a cleaning date less than nine months old, are first subjected to the brake pipe cleaning test, including the branch pipe, the triple valve and release valve. After brake pipe leaks have been remedied the piston travel is adjusted and the brake cylinder tested for leakage. The foundation brake gear is next tested and repairs made to insure that moving parts have ample clearance, that the parts are properly secured and that the levers are standard to the car. The retaining valve is also tested for leakage. If either the triple valve is changed or the cylinder cleaned, the car is considered the same as one with a brake out of date.

Out of date cars, that is, cars having cleaning dates nine months or more old, are treated as authorized for foreign cars by interchange rule No. 60.

PROCEDURE FOR VARIOUS OPERATIONS

The procedure to be followed in carrying out these general instructions is covered by detail instructions for the handling of each part. Only the more important items are referred to here.

Brake Pipe Leakage Test.—Close the branch pipe cut-out cock (except with in-date brakes), and having seen that the opposite angle cock is shut, couple the yard hose, preferably to the retaining valve end of the car, open the adjacent angle cock and charge the brake to 70 lb. Test for and repair leakage from the brake pipe and fittings up to the branch pipe cut-out cock. This includes hose coupling gaskets, leakage under the hose clamp, hose porosity, leakage around the angle cock key under the handle and also the threaded and gasket joints, including the main brake pipe union. With in-date brakes it also includes all of the branch pipe, the triple valve and the release valve. Open and close the angle cock and thereby blow out the brake pipe and the free hose. Listen at the coupler to detect angle cock leakage into the hose, and replace if defective. Then connect the dummy coupling to the hose, open the angle cock and complete the leakage test here. When inspecting for leakage use soap suds where temperature will permit. If connecting with the yard hose or the dummy coupling discloses bent hose couplings, or if hose couplings have broken stop pins, or are otherwise not fit for service, replace the hose.

Piston and Packing Cleaning.—Make certain that the rivets securing the piston to the rod are tight. Remove the packing expander. Turn the flange of the piston packing outward no more than just sufficient to clean the inside of the packing and inspect for cracks, cuts or thin spots that would warrant replacement. Avoid bending any packing more than necessary and clean both sides by dry wiping. If any scraping is necessary use only the dull round corner of the scraper. Kerosene, gasolene and other like mineral oils must not be applied to packing leather, because they remove the filler with which the leather packing is made air-tight, harden and crack the leather, and thus destroy its usefulness. Carefully inspect the piston packing, and if found cracked, cut or worn thin at any point or otherwise defective to cause leakage, replace it with a good one. Note the depression on the packing caused by the expander, as this will indicate any uneven bearing or an expander partly out of place.

Examine the follower for cracks, then measure its diameter, and if it is ¾ in. or more smaller than the rated diameter of the brake cylinder, replace it with one of standard size. If the packing appears good, tighten the follower plate nuts. These nuts sometimes loosen in service and this causes leakage. Clean the joint and flanged portion of the non-pressure head which bolts to the brake cylinder.

Where facilities or conditions will permit, the brake cylinder piston should be removed and taken to a suitable room and cleaned, then tested in a cylinder especially provided for the purpose, this to be followed by the specified test after the piston has been reapplied to the car.

Cylinder Lubrication.—Using the grease brush provided, apply a very thin, uniform coating of standard brake cylinder lubricant to the entire inner surface of the barrel of the brake cylinder, but do not apply any to the piston packing.

Brake Cylinder Reservoirs Loose on Their Supports.—If the brake cylinder moves during application or release, or if any of the cylinder or reservoir bolts are loose or gone, or lock nuts missing, needed repairs must be made by the brake cleaners unless this work has been assigned to other workmen. In this case brake cleaners will not report the brake in good order until any necessary repairs have been completed. One man can observe for movement of the brake cylinder and reservoir and brackets by bleeding off the brakes.

Brake Cylinder Leakage Test.—Use the air gage to test for brake cylinder leakage. With brakes that have just been cleaned, connect the gage to the retaining valve if the latter is the improved type, having the exhaust port threaded for this purpose. On high cars use the ¼-in. hose for making this connection. If the retaining valve is of the weight type, attach the gage to the triple valve exhaust port. In testing in-date brakes, the gage may be attached to the triple valve exhaust port in all cases. Always insure that the plug in the unused exhaust port is tight.

With the brake charged to 70 lb., see that the test gage cock is closed. Apply with a service reduction of 20 lb. and release the triple valve so that the test gage will thereby be connected with the brake cylinder and show the pressure in it. A cylinder pressure of 50 lb. must be obtained before noting the leakage, if any. Try to avoid getting over 60 lb. With the pressure at 50 lb., note the loss of pressure during one minute. If the leakage exceeds 5 lb. per minute with a brake that has just been cleaned, the cause must be found and leakage reduced to not over 5 lb. If it exceeds 10 lb. with an in-date brake treat as an out of date brake—that is, thoroughly clean, repair and test—unless correcting leakage found in the cylinder pipe, cylinder head joint of detached equipment or cylinder head joint of combined equipment reduces the leakage to within the specified amount. The most common sources of brake cylinder leakage are the piston packing, the brake cylinder pressure head gasket, the bottom of the triple valve gasket and, with detached equipment, the pipe connecting the auxiliary reservoir and brake cylinder. With the test gage attached to the retaining valve the leakage may be in the retaining valve pipe.

If temperature will permit, apply soap suds around the piston rod next to the cylinder head. Leaking packing will usually be indicated by bubbles around the rod.

If the pressure rises during the brake cylinder leakage test there is leakage into the brake cylinder past the emergency valve, the check valve case gasket, the triple valve slide valve, the triple valve gasket or an end of the tube in the auxiliary reservoir. If the rise in brake cylinder pressure is three pounds or less per minute, repairs may be omitted, but if it exceeds three pounds, locate the cause and repair before continuing the test for brake cylinder leakage.

Retaining Valve and Pipe Tests.—Test the retaining valve pipe on cars which are fitted with retaining valves not provided with test gage connection or on all in-date brake cars. Turn up the retaining valve handle, charge the brake to 70 lb. and make a service application of 20 lb. Open the by-pass in the test hose attachment and, as soon as the triple valve moves to release position, start at the triple valve and quickly apply soap suds to all of the joints of the retaining valve pipe to determine whether they are tight. Repair any defects found and re-set, repeating until the pipe is tight.

To test the retaining valve pipe of cars just cleaned which are fitted with the improved retaining valves, the test gage will be connected to the retaining valve, and the retaining valve pipe may be tested simultaneously with the brake cylinder. Carefully inspect the retaining valve pipe and correct all leakage before condemning the cylinder packing.

After it has been determined that the retaining valve vent port is open, the retaining valve, when turned up, must hold enough pressure to prevent moving the brake shoes on the wheels with the foot within three minutes after the triple valve moves to release position on the brakes which have just been cleaned, and within 1½ minutes on brakes which have been tested only. It is permissible to jar the vertical section of the retaining valve pipe to aid the retaining valve in seating accurately. A special connection equipped with an air gage may be attached to the unused exhaust port of the triple and the retaining valve pipe pressure shown on the gage, in which case the leakage should not reduce the pressure below six pounds at the end of three minutes after releasing the brake for brakes just cleaned, or at the end of 1½ minutes for in-date brakes.

DISCUSSION

The provision in the cylinder test that newly cleaned cylinders do not exceed a leakage of five pounds per minute and, as recommended by the paper's author, but afterward modified, that on in-date cars the leakage does not exceed 10 lb. per minute for cars less than three months old and 15 lb. per minute for cars over three months old, led to considerable controversy and was quite generally discussed. Some of the members considered this test too severe, which the author of the paper admitted to be the case if the average condition of brake cylinders today were to be used as the basis of judgment. The consensus of opinion, however, was that the test was conservative, and a number of members objected to so liberal a leakage allowance for cars with the older cleaning date. Experience of railroads in various parts of the country indicated that a newly cleaned cylinder which meets the five-pound leakage requirement should be able to keep well within 10-lb. leakage throughout the period between cleaning dates. To accomplish this, however, the work must be properly done when the cylinder is cleaned, a defective leather must not be placed back in service, lubricants must be used very carefully in order to avoid the destruction of the leather filler, and attention must be given to insure against leakage around the follower studs. The necessity for the use of good leather and suitable lubricants was particularly emphasized by several members. The difficulty of getting work done of a quality which would reasonably insure the cylinders keeping within the 10-lb. leakage limit between cleanings as brought out in the discussion was from two causes: first, the difficulty of securing competent labor and of properly training men for this work, and, second, the lack of facilities in many places for properly testing packing leathers and pistons for leakage before replacing them in the cylinders under the cars. The printing in pamphlet form of the instructions in Mr. Purcell's paper for distribution among the foremen and workmen concerned, was suggested as a remedy for the first difficulty and action to that effect was finally taken by the association after several revisions had been made. The remedy for the second difficulty is the provision of facilities inside the shop for cleaning and testing brake cylinder piston and packing leathers. Proper cleaning and inspection of packing leathers and pistons is difficult in the yard in all kinds of weather.

The Safe Movement of Explosives*

Duties of Car Inspectors and Repairers in Respect to Shipments of Explosives and Inflammables

BY D. J. O'DEA
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THE safe transportation of explosives and other dangerous articles is a subject that has required the attention of various classes of railroad employees throughout the United States and Canada during the past ten years. It is a subject that will require constant attention just as long as such articles are transported, for the dangerous nature of these articles remains the same and they must be treated in the manner prescribed by the regulations if we are to guard against injuries to persons and the destruction of life and property.

Literature consisting of the regulations for the safe transportation of explosives and other dangerous articles, bulletin notices giving the details of accidents that have occurred from time to time through the violation of such regulations and pamphlets showing pictures and sketches of the proper and improper methods of loading and bracing explosives and other dangerous shipments, have been circulated for the use and guidance of railroad employees and shippers throughout the United States and Canada, at various times during the past ten years. This distribution of literature, also our lectures and inspections, has been for the purpose of educating all railroad employees who have anything to do with the transportation of explosives and other dangerous articles, and was occasioned by the numerous serious explosions, fires and casualties that occurred on railroads due primarily to the haphazard manner in which these life and property destroying shipments were handled by railroad men and others who had no suspicions of their dangerous nature. Such deplorable single accidents as that which cut off 23 lives, injured 80 persons and caused a financial loss of over one million dollars, naturally caused public consternation and consequent alarm for the future, as similar explosions were bound to continue with the constant increase in the shipping of such dangerous articles, if uniform and stringent measures for their prevention were not promulgated and enforced throughout the country.

Therefore the American Railway Association, representing all of the railroads of the country, inaugurated the Bureau of Explosives for the purpose of carrying on this work. The regulations governing have been adopted by the Interstate Commerce Commission, which was given authority to act on the subject by a special act of Congress in which is stipulated penalties for violations to the extent of $2,000 fine, eighteen months imprisonment, or both, and if death or bodily injury is inflicted the unfortunate party responsible is liable to receive a penalty of ten years imprisonment.

The regulations for the safe transportation of explosives and other dangerous articles is one of many subjects of railroad literature requiring daily observance by the men on the ground, those men whose individual daily actions mean the operation of our great systems of railroads, and whose individual neglect, blunder, or lack of knowledge could stop operations for a time with questionable results, possible disaster, yes wipe out their own existence as well as others.

The regulations on the whole are voluminous, and would confuse a car inspector or car man who would try to memorize them all when only a small part pertains to his branch of the work, but if each of you will study and observe his own little part of the regulations, you will find them brief and simple, and instead of being a hardship they will give you confidence and satisfaction in knowing your duty and that your action was right.

These regulations have been printed and distributed at great work and expense, and it is a pity that many railroad employees have permitted them to remain within their reach without acquiring the good advice they offer, especially when it pertains to some part of their assigned duties.

It must be remembered that the regulations involve many men and duties both in and out of the railroad service, and the neglect or blunder of any one of the many having to do with the handling of a single shipment would be sufficient to render the work of all the others of no avail. It could be the actual or contributory cause not only of destructive fires, but of disastrous explosions, since large quantities of explosives must be transported, frequently through thickly populated districts and in trains containing cars loaded with other dangerous articles.

The specific duties applicable to car inspectors and car men generally are of the most importance. The essential part of any line of business is a complete knowledge of it; it is folly to expect men to do right by these shipments of explosives and other dangerous articles if they have not been properly instructed and furnished the necessary information on the subject. Unfortunately the car inspectors and car men have been the most neglected class of railroad employees in this respect in not receiving instructions pertaining to their part of the work involved in the regulations for the transportation of explosives and other dangerous articles.

EXPLOSIVES

There are three distinct classes of the explosives and other dangerous articles for especial attention by car inspectors under the regulations, namely: Explosives for which a certified car is required, the inflammables and the acids. These are the placards required on cars containing them, four placards to the car, one placard applied to each end and each door or side. The principal warning on the "Explosives" placard for car men is that portion in large letters: "EXPLOSIVES, KEEP FIRE AWAY." The condensed rules printed thereon for the handling of the car are also well for car inspectors to note and aid in having any violations of them corrected when observed, but this placard must always be accompanied by the car certificate, one on each door.

As the law requires that cars for explosives shall be in exceptionally good condition, so also it requires that they shall be inspected by men who know how and certified to so it will be known that the proper precautions were taken at the originating point. This certificate is to be executed in triplicate, two for the car doors and one to be kept on file at the originating point. There are two portions to the certificate, number one to be signed by the railway employee inspecting the car, which reads:

No. 1.

I hereby certify that I bave this day personally examined.................car No..............and that the roof and sides have no loose boards, holes, or cracks, or unprotected decayed spots liable to hold sparks and start a fire; that the kingbolts or draft bolts are properly protected, and that there are no uncovered irons or nails projecting from the floor or sides of the car which might injure packages of explosives; also, that the floor is in good condition and has this day been cleanly swept before the car was loaded; that I have examined all the axle boxes, and that they

*Abstract of a paper read before the Niagara Frontier Car Men's Association.

are properly covered, packed, and oiled, and that the air brakes and hand brakes are in condition for service.

This is practically a legal document, and when a man signs it he is holding himself responsible under the law for the proper condition of the car and should be sure that he knows that the car complies with the requirements of the regulations before he applies his signature.

It seems incredible that a man would sign his name to a document without knowing its reading, but I have found instances where these car certificates have been signed by car inspectors in such a perfunctory manner. A short time ago after a car inspector had completed his inspection of four cars for explosive shipments at a transfer station, I questioned him about the inspection work while he was signing the certificates. He paid no attention to the car numbers nor the number of certificates he was signing, and admitted that he never received a copy of the regulations nor read the car certificate and was signing for something he knew nothing about.

Practically all the car inspectors' duties pertaining to shipments of explosives are covered by one regulation, No. 1662. Considerable wrong has occurred by this class of employees doing their part of the work with their own judgment or ideas as a basis, instead of using regulation 1662 for their guide. Many inspectors considered the roof of an explosive car perfect because it was metal on the inside, whereas the regulations clearly show that the outside needs careful inspection to guard against fires from sparks holding in open or decayed spots. One fire from such a cause exploded a car of 500 cases of dynamite. The outside roof was bad, permitting a spark from a passing train to lodge and set it afire. The placard warning and consequent fear of an explosion kept people away, so there was only a property loss of $7,000. Another fire from the same cause exploded a car load of dynamite, killing two persons and causing a property loss of $8,300. The roof of another car which contained black powder caught fire from a spark of an engine and the fire spread to three other cars on a siding loaded with dynamite. All four cars exploded with a property loss of $10,891.

These heavy losses could have been avoided by the car inspector at the originating point completing his work with the proper inspection of the outside of the roof, or by an inspector at one of the interchange points through which the cars passed detecting the defective roofs. This part that pertains to interchange inspections and many other defects existing during transit with cars containing explosives, emphasizes the necessity of a careful inspection at interchange points as required by regulation 1654 *a* and *b*. In addition to the possibility of defects being overlooked at the originating point, defects are liable to develop during transit.

From the fact that the car inspector at the originating point is called upon especially to inspect a car intended for explosives and is required to sign the car certificate covering such inspection, he knows positively that the car is for explosives and the nature of the special inspection required, but it has been the common practice to assume that during transit the car inspectors would know the explosive car by the placards. In many instances this has proved unreliable, as usually the car inspector is rarely looking up for placards and on account of the infrequency of such placards in some districts, to some inspectors it would be like looking for a needle in a haystack to be looking for cars placarded "Explosives." The most practical way of having a car inspector at an interchange point know the car that contains explosives, in order to make certain that he actually inspects it as such, is to inform him of the presence of such a car.

Part of regulation 1662 reads as follows:

Holes in the floor or lining must be repaired and special care taken to have no projecting nails or bolts or exposed pieces of metal which may work loose or produce holes in packages of explosives during transit.

When packages of explosives are to be loaded over exposed draft bolts or kingbolts, these bolts must have short pieces of solid, sound wood with beveled ends (2-inch plank) spiked to the floor over them (or empty packages of the same character may be used for this purpose) to prevent possibility of their wearing into the packages of explosives.

It will be noted that this only applies to metal so located that it would injure the packages. To condemn a car for use of explosives because it has a metal band across the door sill, or exposed metal in other parts where the shipment would not be placed, is wrong. The regulations are clear on these points, and inspectors must stop adding risks by causing delay to shipments at transfer and other stations through their neglect to follow the printed regulation. Delays of two to four days have occurred at some stations on account of inspectors reporting cars unfit for explosives when as a matter of fact they were condemning cars improperly in this manner.

Of course there is quite a difference in the inspection required by these regulations for a car intended for explosives as compared with the inspection given the ordinary run of cars for merchandise and other shipments. I recall that at one large freight station an agent's faith in the thoroughness with which inspectors examined cars at all times was very much exaggerated, as he felt certain that all his cars were examined as thoroughly as any intended for explosives. The foreman of car repairs at that point expressed his opinion of the difference between such inspections thus: If his inspector spent two minutes looking over a car for the ordinary run of merchandise freight he would discharge him as too slow for the pob, but if he did not spend about three to six minutes inspecting a car intended for explosives he would consider him as not careful and thorough enough for such inspections, for he would expect as careful inspection of such a car as would be given a passenger car. Some cars of course can be inspected faster than others, a metal roof on the outside being easier to inspect than and old wooden roof; rust coated trucks and wheels fairly well worn require a slower inspection than a new or comparatively new car.

While the dangerous nature of explosives and other dangerous articles and the alarming consequences they are liable to cause in their transportation, emphasizes the great importance of particularly caring for such shipments in the manner prescribed by the regulations, it also emphasizes the importance of the car man's duties being thorough with all cars regardless of the nature of the lading. Many train accidents in which explosives and other dangerous articles were involved and through their presence added exceedingly heavily to the injuries to persons and the destruction of life and property, were the result of defective equipment other than that which contained the explosives and other dangerous articles. While the regulations provide that "at points where trains stop and time permits, cars containing explosives and adjacent cars must be examined to see that they are in good condition and free from hot boxes or other defects liable to cause damage," the importance of the car man's duties being thoroughly performed at all times should be constantly remembered.

All explosives are required to be well packed in specified containers when offered for shipment and properly loaded and braced in the cars for forwarding. However, the shocks cars receive incident to yard and road movement sometimes have the effect of breaking the bracing or the packages, permitting the contents to leak or become exposed. The records of our Bureau show many such instances. Therefore, essential requirements are to keep fires away and when inspection or other work at such a car is necessary after daylight hours, naked lights must not be used. Extreme caution must be exercised to prevent the striking of sparks or permitting the friction of tools, bolts, rods or other metal parts of the car to come in contact with loose explosives, or for such metal parts to wear through and damage the packages. A draft bolt was found broken in a car containing fifty cases of dynamite. The car repairer while replacing a draft bolt in the car struck some of the loose dynamite that settled around the bolt, burning his face and injuring both eyes. A serious accident was narrowly averted. The broken draft bolt may have been due to poor inspection at the loading point.

Many other simple acts have resulted in serious accidents with shipments of explosives. Nitroglycerine, the liquid ingredient of dynamite, leaking from containers through to the wheels and rail, caused it to detonate when the car was moved, exploding all in the car with the loss of several lives any many thousands of dollars' worth of property. One of the kegs in a shipment of black powder was found in a damaged condition with powder strewn over the car floor. After putting back in the keg what could be readily picked up from the floor of the car, the remainder was swept out on the ground. A bystander thoughtlessly threw a lighted match on the ground among the sweepings. There was an immediate flash which communicated to the kegs of powder in the car, with the result that fourteen persons were killed and eight injured. In a similar instance, a way-freight conductor instead of disposing of loose powder in the manner prescribed by the regulations and complying with the warning given on the placard, knew just enough about the characteristic of black powder, as he thought, to have some fun with it. Some powder was loose on the car floor from defective packages, and after picking up most of it he swept the remainder out on the ground. It was on a Southern road where colored men were employed as trainmen, and knowing that the loosely scattered powder would merely flash when lighted, it was thought a fine joke to get a colored man in the center of the scattered powder and then light it. The conductor and some of his men accomplished this and were enjoying a hearty laugh, when suddenly all the powder in the car exploded, killing them and some children who were playing nearby, a total of eight lives sacrificed. In the excitement of the joke, it was not considered that a small spark of the ignited powder would flash up into the car and explode all with such a disastrous result.

Loose or scattered black powder is exceedingly dangerous, and it is very odd how far a trail of it will carry fire when it catches a spark. In the city of Wilmington, a wagon loaded with powder was being driven along the street. One of the kegs had a hole from which powder escaped in small quantities, and a man driving a fast trotting horse two blocks away, crossing the street at right angles, through a spark produced by the shoe of the horse striking a cobble stone, ignited this trail of powder. The fire followed that wagon two blocks, caught up with it and exploded the entire load.

Such instances show the care that should be taken with any trail of powder from leaking packages around freight cars.

HAZARDS OF INFLAMMABLE AND ACID SHIPMENTS

While a mishap with explosives is capable of great destruction, accidents with the inflammable and acid shipments have been the most numerous, and when measured by loss of life, number of personal injuries and extent of damage to property, one of the most disastrous accidents that can be traced to the transportation of dangerous articles, occurred in September, 1915, with a tank car load of gasoline. Forty-seven persons were killed and 524 persons were injured. The property loss was over one million dollars. The greatest hazard with inflammable shipments has been with the movement of inflammable liquids.

Cars containing fireworks, smokeless powder, inflammable solids such as matches, chlorate of potash and various other articles liable to catch fire through friction or by being dropped or crushed or by spontaneous combustion; inflammable liquids like gasoline, liquified petroleum gas, bisulfide of carbon, naptha, benzol, alcohol, and some paints and varnishes; compressed gases such as acetylene, hydrogen, blaugas, hydrocarbon, must be protected by four "Inflammable" placards, one applied to each end and each side.

The three notes on the bottom of these cards are also important. They read:

1. This car must not be next to a car containing explosives.
2. Do not enter with exposed flame, nor with lighted lantern, until car has been ventilated and vapors allowed to escape.
3. When lading requiring this placard is unloaded from box or stock cars, Agents, Yardmasters and Conductors must remove the placards. Tank cars must retain placards until cleaned.

Accidents have happened frequently due to men not obeying these warnings, by car inspectors and others poking a torch, lighted lantern or match around a leaking car or in the dome of an empty tank car. The ordinary trainman's hand lantern is responsible for a large number of these accidents, and car inspectors and others are in the habit of utilizing their torches or hand lanterns for the purpose of making inspections of such cars. It is probably due to lack of knowledge that some fatalities have resulted from the use of such lights in connection with work at night, and employees should be impressed with the importance of observing the caution to keep lights and fires away. A leaking container of any inflammable is a hazard, and the best time to examine it or to do any repair work on a car protected by "inflammable" placards is during the daylight hours.

The inflammable solids or oxidizing materials when combined with combustible or organic matter may cause fires spontaneously. For example, permanganate of potash if it gets out of its package and becomes mixed with organic matter, such as may be found in the ordinary dirt of a freight car, may ignite of its own accord, or when an attempt is made to pick it up with a shovel a spark may be created which may cause ignition of the entire mass.

Inflammable compressed gases if leaking from their cylinders are readily ignited by the presence of an open flame or lighted lantern, and the ignition of these gases may result in a serious explosion and fire that may be far-reaching, for the reason that when the gases mix with the air they form an explosive mixture.

In the treatment of tank cars which are protected by the inflammable placard, or by the acid placard, according to whether the contents are inflammable liquids or acids, their handling deserves careful attention on the part of car men. The regulations require such cars to comply with the Master Car Builders' rules and when they do not their transportation is forbidden. When such cars are set out for M. C. B. defects and in addition may exhibit leaks at the seams, rivets or outlet valves, there is danger of ignition of the vapors escaping from inflammable liquids, or if the leaking liquid is acid, danger of serious burns to railroad employees. It is customary for well instructed men to stop leaks through the seams or rivets of tank cars by caulking the metal, and this can be done with reasonable safety even when the tank is loaded with gasoline. The question of whether bronze rather than steel tools should be used for the caulking has been considered, and our investigation justifies the conclusion that there is no case on record of any serious fire caused by the use of steel tools. Steel tools are more efficient for this purpose. In some instances it would be quite difficult if not impossible to caulk a seam by the use of a bronze tool. Such work on an empty tank car is dangerous, and the best method is not to permit the caulking of an empty tank car until the tank has been steam cleaned, unless it is known that it previously contained a substance that would not cause gas to remain in the tank. If the leak from a tank car is very bad, attempts should not be made to repair it, but the contents should be transferred as quickly as possible to a suitable car.

The presence on the inflammable placard of "Keep Lights and Fires Away" is not always sufficient to act as a warning, and a guard is a more reliable means of preventing the possibility of a serious accident. In a recent case when it was impossible to stop a leak at an outlet valve, every person in the railroad yard was notified of the presence and location of the tank car. Some employees owning automobiles saw an opportunity of getting gasoline without expense. This operation was performed safely during daylight hours, but when a night yardman came on duty he proceeded to steal some of the gasoline, using his lighted lantern for the purpose of seeing when his container became filled. A very serious fire followed and the employee was badly burned. The presence of an active guard could have prevented this. The Bureau's records show many instances of personal injuries and serious fires caused by employees attempting to pilfer gasoline and alcohol from tank cars.

One of the most dangerous substances handled by railroads in tank cars is casinghead gasoline. The regulations require that tank cars containing this material should bear on the top of the dome cap and on each side of the dome, a special placard reading:

CAUTION

Avoid Accidents

Do Not Remove This Dome Cover While Gas Pressure Exists in Tank. Keep Lighted Lanterns Away

The regulations also require that tank cars containing this liquid shall be equipped with a mechanical arrangement for closing of dome covers as called for in the M. C. B. specifications, and this arrangement must either be such as to make it practically impossible to remove the dome cover while the interior of the car is subjected to pressure; or suitable vents that will be opened automatically by starting the operation of removing the dome cover must be provided. One of the most serious accidents in the history of the railroads occurred in September, 1915, due to the opening of a dome cover of a tank car containing casinghead gasoline, although it was known at the time that interior pressure existed.

The regulations require that safety valves on tank cars containing any of the inflammable liquids that give off volatile vapors at or below a temperature of 20 deg. F. shall be set to operate at a pressure of 25 lb. per sq. in., as a safety precaution to prevent the frequent unnecessary escape of the vapor. The Master Car Builders' Specifications for tank cars, with which your duties require you to be familiar, covers in detail the essentials in this respect applicable to the various volatile and acid products.

The regulations require that empty tank cars that previously contained gasoline or any of the other liquids requiring the inflammable placard must retain such placards until the cars are known to have been properly cleaned with steam or reloaded with a substance that does not require the placard. Many fatal accidents have resulted from using lanterns or lighted matches to repair unsteamed tank cars, which may contain inflammable vapors even when the previous lading was not of a flash point below 80 deg. F. Only incandescent electric lights should be used for this examination.

An empty tank car, which had previously contained fuel oil, was being repaired. While a shopman with a lighted lantern stood over the open manhole of the dome an explosion occurred which threw him to the rafters of the repair shop shed and dropping back on the car he was fatally burned, dying a few hours later. A number of other employees were burned by the fire that followed, which destroyed the repair shop and all the cars in the vicinity with a heavy property loss.

While repairing an empty tank car which had previously contained naphtha, a red-hot rivet was passed to one of the employees inside of the tank, which ignited the gases, killing the employee in the tank and seriously burning the other. This car had been empty for seventeen days, but had not been cleaned by steam.

A repairman arranged to rivet a grab iron on the end of an empty tank car which had previously contained gasoline. His helper entered the tank but came out saying the vapors were too strong for him. The repairman then enterd the tank and instructed his helper to hand him a hot rivet. When the rivet entered the manhole an explosion occurred, severely burning the repairman who died two hours later.

Inspection by a car inspector and repairer was being made of an empty tank car which previously contained gasoline. They removed the dome cover to ascertain whether the car contained any liquids and the inspector thoughtlessly struck a match. The vapors were ignited and an explosion followed, severely burning the inspector.

These are only a few of the many similar accidents that have occurred to car men on empty tank cars.

Leaking packages of inflammable or corrosive liquids when observed should be immediately taken care of. If in doubt a call should be made for some authorized and competent railroad employee to supervise the removal of the leaking packages from the car.

PRECAUTIONS IN CASE OF FIRE

The best manner of extinguishing firse depends upon the immediate existing local conditions. Fires caused by nitric acid or mixed nitric and sulphuric acids can be controlled by the use of water. In applying the water care must be exercised as slight explosions may occur, accompanied by the projection of hot acid, which may cause dangerous burns. Therefore, the water should be applied from a safe distance. Sand may also be used to stop a fire started by acid. But if the fire has thus been stopped the early use of water is desirable to prevent the fire breaking out again. Thoroughly flush away any remaining acid and remove leaking and damaged containers. Acid fires give off nitrous fumes which are extremely irritating and are poisonous. Employees should not enter a car or other confined space where such fumes are present.

Fire in a car of friction matches frequently involves ignition of the match heads in only one or a few of the inside cartons. If the outside box is not broken open and the smoke dies away after a moment or two, no further action is necesary as the fire has already been extinguished for want of oxygen, and nothing will be gained by opening the box. If the fire has gained some headway, the burning box or boxes should be removed from the car if this is possible, or water should be freely used. Boxes should not be broken open as the fire will be increased by such action.

Fires in ground charcoal or in charcoal screenings are best handled by removing the burning packages (usually bags). If removal is not possible, water may be used sparingly to extinguish the visible fire; then remove all the charcoal and separate the wet from the dry. The dry charcoal should be stored under cover and under observation for several days before permitting it to be forwarded as it is probable that fire may burst out again. The wet charcoal should be destroyed as it is unsafe to transport. Fires in lump charcoal should be extinguished with as little water as possible and the wet charcoal removed from the balance of the lading. The same precautions as to observation for several days should be followed to see that fire does not occur again.

Fires which involve only a small amount of gasoline can often be extinguished by the liberal use of water, but if there is a large amount of gasoline already ignited, water will only spread the fire. Sand or earth should be used to control the flames of the burning gasoline, and could possibly be used in sufficient quantity to smother the fire.

Fires involving tank cars may occur through ignition of the vapors escaping from the safety valve. The burning of these vapors and even the liquid itself at a safety valve is not a serious matter except as a source of trouble to surrounding property. An effort should be made to promptly extinguish such fires by the use of wet bagging thrown over the safety valve, throwing sand in quantity on top, or if the means are available, by the use of a heavy jet of steam. If this cannot be done, isolation is the proper course to pursue, and the fire will eventually burn itself out.

If in repairing cars containing dangerous lading it is necessary to disturb the lading, care must be exercised to properly load and brace it before the repaired car is permitted to go forward.

The Interstate Commerce Commission regulations require that carrier's employees shall report all violations of the regulations observed, and car defects constitute serious violations of the regulations which should be reported to the proper railroad official. These reports are our best means of guarding against a repetition of violations before they result in more serious consequences.

As the regulations place upon the carriers a duty to make the regulations effective and to thoroughly instruct their employees in relation thereto, in turn the carriers necessarily hold trainmasters, yardmasters, station agents and those who have men under their jurisdiction, responsible respectively for the proper instruction of the employees under them and for their compliance with the regulations. Therefore, it is essential that chief car inspectors and foremen protect themselves with a suitable means of instructing employees under their jurisdiction and insuring compliance by them with the regulations. The monthly or periodical business meetings of car men that are in practice on some roads affords an excellent opportunity to include subjects pertaining to the regulations for discussion and instruction of the car men, who should be furnished literature pertaining to their part of the duties involved. The use of the accident bulletin issued quarterly by our Bureau also serve as an excellent means of imparting knowledge on the subject.

After proper provision is made for the instruction of employees, it is still incumbent to know that the regulations are actually complied with by them when the occasion arises. Such a knowledge can be obtained by a periodical check of the work of the various employees.

Before any work is commenced on any cars containing explosives or other dangerous articles, it should be the rule that some specially posted employee will inspect the car and supervise the work. By having some system for the handling of these subjects, a chief car inspector or foreman can then have some assurance that he has guarded against trouble or disaster with the employees and property under his jurisdiction.

ALL-METAL PASSENGER CARS FOR BRITISH RAILWAYS*

Before the war the supplies of lumber for rolling stock in Great Britain were adequate at comparatively low prices, but at the present time, the conditions have changed entirely. The United Kingdom has in the past imported about 90 per cent of its requirements but with the decrease in the available vessels since the war the problem of getting the lumber into England has been a difficult one. At the present time the British imports of timber are two years in arrears and on account of the present demand for this material on all sides, it is estimated that it will not be less than five years before the demands for lumber for railway rolling stock can be met as in pre-war days. On the other hand, the metal output of Great Britain has greatly increased during the war and there would be no difficulty in supplying the 20,000 tons of metal per year necessary for the construction of passenger car bodies required by the railway companies. Furthermore, the prices of iron and steel have increased but about 124 per cent since 1914, whereas the price of lumber has increased about 218 per cent. Thus the development of the all-metal passenger car appears to be a natural evolution.

*Taken from a paper presented by F. E. Gobey, assistant carriage and wagon superintendent, Lancashire & Yorkshire, England, before the Institution of Civil Engineers, London.

There are in Great Britain 52,250 railway passenger cars. They are mainly of wooden superstructure. A large number, however, have all-metal or composite, lumber and metal, underframes. Table I indicates, in brief, the general construction of passenger cars on fourteen railways in Great Britain:

TABLE I—SUMMARY OF PASSENGER CARS OWNED BY FOURTEEN RAILWAY COMPANIES, JULY 31, 1918, SHOWING THE AMOUNT OF TIMBER AND METAL CONSTRUCTION

BODIES

Built of	Number of cars	Percentage of total
Timber	46,133	95.9
Timber with metal outside panels	1,761	3.7
Composite, timber and metal	158	0.3
Metal entirely	46	0.1
Total	48,098	100.0

UNDERFRAMES

Built of	Number of cars	Percentage of total
Timber	592	1.2
Timber, with metal plate on solebars	19,750	41.1
Timber, with metal angle or channel on solebars	6,469	13.4
Composite, timber and metal	4,569	9.5
Metal entirely	16,718	34.8
Total	48,098	100.0

The number of cars given in this table represent 92 per cent of total number of passenger cars in Great Britain.

Most of the six-wheel passenger cars have iron or steel plates ½-in. thick on the outside of wooden side sills and the four-wheel truck cars use either the steel plates or angles or channels. In some cases they have composite underframes with rolled steel side sills and bolsters. However, the all-metal underframe and truck has been the standard practice since 1900. The average weight of metal in a modern passenger car, 56 feet long, with a steel underframe and wooden body is 41,500 lb. or 66 per cent of the total weight of the car.

The design of British cars with numerous side doors which break the continuity of the body as a girder, has made it necessary for the superstructure and load to be carried by the underframe. The bodies of this type are designed to keep free from distortion. The underframe is calculated to sustain, in addition to the weight placed upon it, strains due to buffing and drawgear, oscillation, and vibration. The British standard underframe for passenger cars with wooden superstructure is composed of four longitudinal members with bolsters and cross-bars all in the same plane suitably trussed.

TABLE II—COMPARISON OF GENERAL DIMENSIONS OF BRITISH AND AMERICAN MULTIPLE-UNIT ELECTRIC CARS

	Long Island		Lancashire & Yorkshire	
	Ft.	In.	Ft.	In.
Length over body corner posts	54	9¾	..	..
Length over buffers	64	5¾	65	3
Width over body	9	9¾	9	4
Width inside body	9	4½	8	11½
Width over cornices	9	11½	9	2
Width over belt rail	9	10¾	9	3⅛
Height from rail to top of roof	13	0	12	4½
Height from rail to top of ventilators	13	8¼	12	8⅞
Height from rail to top of floor	4	4⅝	4	1¼
Height from rail to center of buffers	2	10½	3	6
Center to center of trucks	39	9	45	0
Wheelbase of trucks				
Number of passenger seats	80		95	
Weight of car unloaded	63,100 lb.		64,960 lb.	
Weight of car without trucks	45,100 lb.		42,504 lb.	
Weight of one truck	9,000 lb.		11,228 lb.	
Weight per seat	788 lb.		683.7 lb.	

The only railway passenger cars constructed entirely of metal in Great Britain are those used in the electric service of the Lancashire & Yorkshire, between Lancashire and Bury, which uses the multiple-unit control system. These cars are like the American type of passenger car in that they have the center aisle with the doors opening onto platforms at the ends. However the Lancashire & Yorkshire cars have seating space for five passengers across the car, three on one side of the aisle and two on the other, the aisle being much narrower than in American cars. The general dimensions of these cars are shown in Table II together with those of similar cars used on the Long Island in its electric service in the United States.

In order to show the small amount of difference in weight between the all-metal, as designed by the Lancashire & Yorkshire for its electric service between Manchester and Bury, and the composite type of construction used between Liverpool and Southport, the dimensions in Table III are given. It should be stated, however, that the cars with timber bodies have an underframe of a heavier type of construction than the all-metal car, the latter being of more recent construction. The elliptical type of roof of the all-metal cars is also lighter than the clerestory type on the wooden cars and, further, there are more seats in the all-metal car which reduces the total weight per passenger seat.

Table III—Comparative Weights of Electric Motor Cars

Description	Liverpool and Southport wood cars				Manchester and Bury all-metal cars	
	Third class D.C. motor car		Third class M.U.C. motor car		Third class M.U.C. motor car	
	Ft.	In.	Ft.	In.	Ft.	In.
Length over body	60	0	60	0	63	7
Width over body	10	0	10	0	9	4
Height of car inside, floor to roof	8	0½	8	0½	8	3¼
Height of car from rail level to floor	4	4¼	4	4¼	4	1¼
Height of car from rail level to top of roof	12	7⅞	12	7⅞	12	4½
Center to center of trucks	40	6	40	6	45	0
Wheelbase of trucks	8	0	8	0	9	0
Type of roof	Clerestory		Clerestory		Elliptical	
Number of seats	69		68		74	
Weight of body and underframe, with draft and brake gear	47,110 lb.		51,188 lb.		39 592 lb.	
Weight per passenger seat, body and underframe only	682.7 lb.		752.7 lb		535 lb.	
Weight of two trucks complete	53.150 lb.		53,150 lb.		62,719 lb.	
Weight of other electrical equipment, including cables, per car	6,760 lb.		9,902 lb.		18,649 lb.	
Total weight unloaded	106.960 lb.		114,240 lb.		120,960 lb.	
Weight per passenger seat of total weight unloaded	1,550 lb.		1,680 lb.		1,634 lb.	

The difference in the cost of the two cars mentioned above is slight, the all-metal car costing about 4.8 per cent more than the wooden car with an all-metal underframe.

During the three years the all-metal cars have been in service they have averaged 250,000 miles a year. There has been no weakening of the underframe or superstructure. It was found that where aluminum, which is used for the side panels and roof sheets, comes in contact with Flexolith it will oxidize, and the aluminum in such cases has been replaced with brass. While the cars have not been in service long enough to make any direct maintenance comparison with wooden cars it is believed that slightly less material and labor will be required on the all-metal cars.

As will be noted above these cars are built with aluminum side panels and roof sheets, and it is claimed that a return of 20 per cent a year saving will be made, based on the reduction in weight, and considering the interest on the increased initial outlay. The saving amounts to 1,623 lb. per car.

An aluminum with a tensile breaking load of 24,600 lb. per sq. in. is not suitable to replace steel having a breaking load of over 62,800 to 71,600 lb. per sq. in. for framing purposes but with alloys, of both aluminum and steel, metals of sufficient strength may be used with a reduction in weight.

As regards standardization, aside from the uniformity of width and length, there is little or no advantage in the standardization of the superstructure of a passenger car, for it will last the life of the car. Commercial advantages will be obtained by the use of standard rolled sections, pressings, doors and mouldings, however, in the construction of the car. It is believed that if metal construction is adopted, the old compartment carriage should give place to the car with the center aisle such as is used in America. This type of car for main and suburban electric services in England should have a minimum inside width of 8 ft. 11½ in. This will give more seating space per passenger than the present four-a-side compartment in a side corridor car, as it will allow three passengers on one side of the aisle and two on the other.

From a study of the designs of the center aisle cars, it has been found that the weight of the car per seat diminishes as a length of 65 ft. is approached, due to the excessive girder constructions required for the underframe on cars of such length. A study of the conditions in England discloses the fact that the economic car for a suburban electric service would have a length of 63 ft. 7 in. Such a car with a center aisle with three passengers on one side and two on the other would have a seating capacity of 103 and the weight per passenger seat would be 560 lb. For long distance main line cars additional comfort to the passengers will be obtained by having seats for two passengers only on each side of the aisle.

The all-metal open car has the following advantages over ordinary compartment cars of timber construction:—

(a) Increased inside width due to the framing being thinner.

(b) A body which may be built to the full limit of the load-gage for the paying load.

(c) The deletion of the side corridor and cross partitions, saving 1120 lb. in weight.

(d) Seats will be better occupied, making each car more remunerative, and reducing the weight of trains.

(e) An open aisle, which allows the circulation of passengers, and may be passed along comfortably, even if of less width than an enclosed side corridor.

(f) Few outside doors, reducing initial cost, maintenance, and traffic-staff duties.

(g) Greater strength of car side, which, if desired, may be used as a girder.

(h) Saving of interest by gradual reduction in the present stocks of timber.

(k) Simplification of parts.

(l) Greater safety in case of accident.

There is no comfort provided by the existing main-line small passenger compartment cars which cannot be secured in an open aisle all-metal car. In suburban cars where frequent stops are made, the weight should be reduced to a minimum consistent with safety and proper maintenance. Main-line cars must be built to resist greater stresses and must provide protection for passengers in case of accident.

Automatic center couplings without side buffers have been very successful in the electric service of the Lancashire & Yorkshire during the last 15 years for train speeds up to 60 m. p. h. and the development of the coupler will be to automatically engage also the brake and electric connections. In England practically all the station platforms are elevated a certain amount above the rail to accommodate the side door compartment cars. Thus the conditions are such that on main-line cars steps from the vestibules will be necessary on account of the varying height of the station platforms above the rail level.

While much has been said about the adoption of the open aisle car in contrast with the side door compartment car, it might be said that it is not necessary that the open aisle car be used with the change from a timber to metal construction.

Throughout the discussion of this subject the author frequently referred to the practices followed by the railroads of the United States in all-metal car construction.

Plight of Russian Railways.—The Russian railway system threatens to collapse, owing to the fact that no repairs have been effected since the revolution, says an article in the Reconstruction Supplement of the Review of the Foreign Press issued by the British War Office. The station buildings are for the most part deserted, the warehouses falling in, and the central switches and signaling apparatus no longer work, owing to the lack of spares with which to replace the wornout parts.

SHOP PRACTICE

FURNACE FOR BRAZING COPPER PIPE

BY E. A. M.

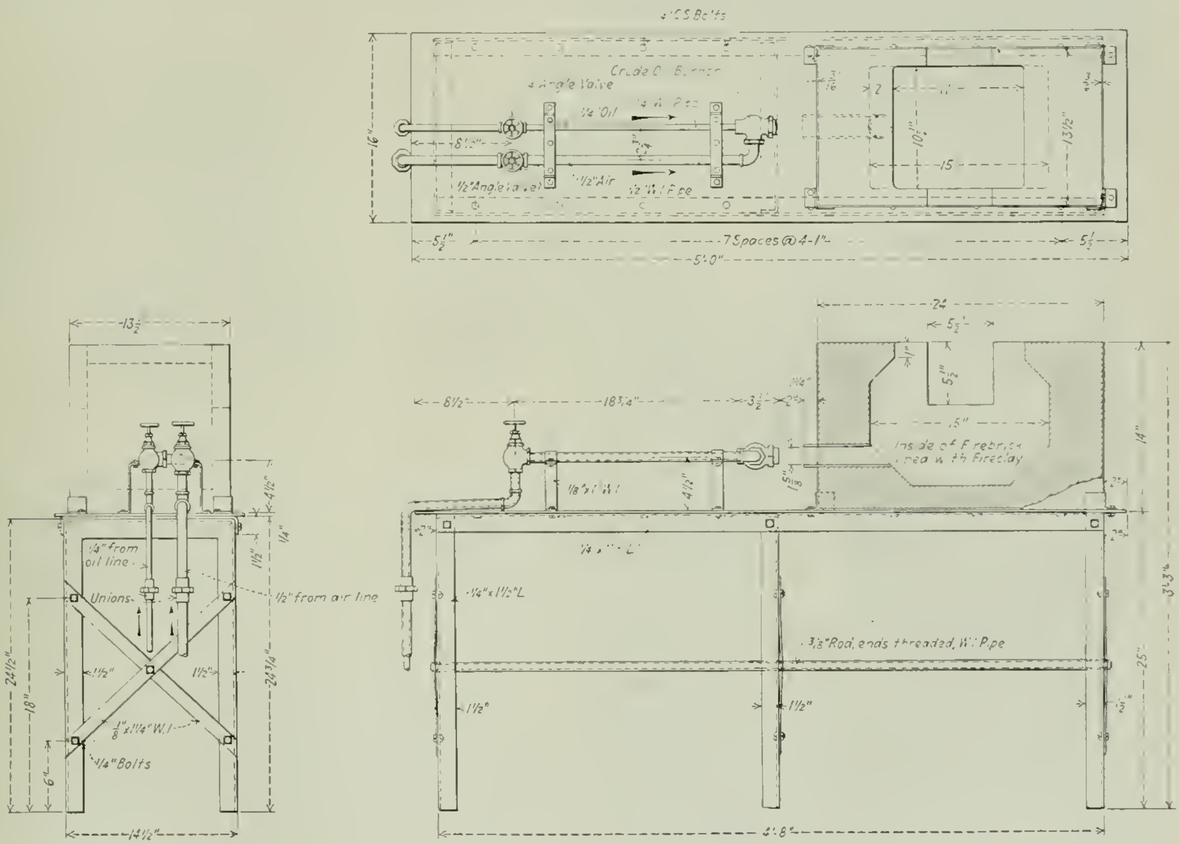
The furnace shown in the drawing is a shop made device which should prove very convenient for use in brazing copper pipe.

The furnace itself occupies a space measuring 24 in. by 13½ in. and stands 14 in. high. It is mounted on a rigid table, built up of angles, flat sections and tie rods in wrought iron pipe sleeves, and is covered with a top of ¼-in. steel or iron plate. The table is 4 ft. 8 in. long and just wide enough to conveniently hold the furnace at one end. The remainder of the top holds the burner and the air and oil supply pipes and control valves.

The furnace box is built of ⅛-in. or 3/16-in. sheet metal, with angles on the outside of the corners. It is lined with firebrick and the combustion chamber is finished with fire clay applied to the brick. Openings 5½ in. wide by 5½ in. deep are cut through the sides of the furnace to permit the pipe to be passed through the combustion chamber. The top of the box is left open, but a piece of plate may be provided which will serve as a cover when desired.

Through one side of the furnace, near the bottom of the combustion chamber, is a 1⅝-in. pipe. This forms an opening in front of the burner, which is held in position by 1-in. by ⅛-in. iron supports from the top of the table. The burner is fed by a ¼-in. oil supply pipe and a 1½-in. air pipe, controlled by angle valves. The valves are located above the top of the table about two feet from the end of the furnace. As shown in the drawing, the device is intended to use crude oil.

This furnace has been used very successfully to handle up to 4-in. copper pipes and no doubt could handle even larger sizes if occasion required.



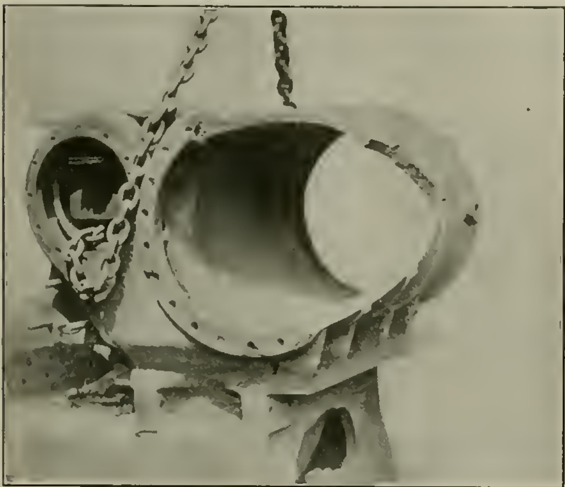
A Conveniently Arranged Furnace for Pipe Brazing

WELDING LOCOMOTIVE CYLINDERS

BY J. B. TYNAN
Superintendent Shops, Wheeling & Lake Erie, Brewster, Ohio

The possibilities of reclamation by welding are forcibly illustrated by the repairs made to a locomotive cylinder casting in the Wheeling & Lake Erie shops at Brewster, Ohio. A cylinder casting having a large section of the barrel broken off, was successfully repaired by gas welding.

In making repairs to this cylinder a pattern of the missing



The Broken Casting as Received in the Shop

part was first made and a patch casting, weighing 505 lb., cast from iron scrap. The rough edges of the cylinder were chipped to an angle of 45 deg. and the patch fitted and

The Cylinder Casting After Welding and Boring

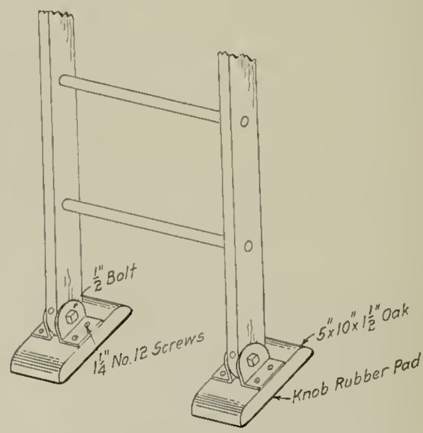
bolted into place. A furnace of brick was then built around the cylinder, with an opening at one end large enough to admit an oil torch, and the entire casting was brought to a red heat before the welding was begun. The patch was then welded to the cylinder and the old stud holes also welded shut. An oil burner was kept burning inside of the cylinder until the welding was completed.

After the welding was completed the furnace was filled with pine wood and the cylinder kept at a cherry red heat for seven hours. The furnace was then closed as tightly as possible and the cylinder allowed to cool slowly. After being thoroughly cooled, the cylinder was bored and the face finished ready for new stud holes. This method of repairing gave satisfactory results and eliminated a long wait for a new cylinder casting, thus enabling the shop to turn this locomotive out for service in a comparatively short time.

SAFETY NON-SLIP SHOE FOR LADDERS

BY A. G. JOHNSON
Mechanical Engineer, Duluth & Iron Range, Two Harbors, Minn.

A safety non-slip shoe for use on ladders is shown in the illustration. This shoe is made of hardwood blocks with two clips of No. 10 gage steel plate, formed and drilled, and attached to the ladder as shown. These plates may be selected from boiler shop scrap. A pad of rubber is glued and then nailed to the underside of the hardwood blocks, which



Application of the Non-Slip Ladder Shoe

prevents the ladder from slipping while being used on a hard or smooth surface. These shoes have been in use in the shops, roundhouse and power plant of the Duluth & Iron Range for a number of years and have given very satisfactory service when used on concrete or other hard floors, preventing slipping of the ladder and possible injury to the person using it.

Rustless Steel.—A new Sheffield invention is a rustless steel having a bright surface and able to resist the corroding effect of air, water and acids without staining. It was chanced upon largely by accident, just prior to the outbreak of the war and was immediately commandeered by the British government for use in airplane construction and for purposes where strength and durability, combined with rust resisting qualities were invaluable. A local metallurgist, Harry Brearly, author of numerous standard works, was experimenting in the armament shop to find a means of preventing erosion in gun tubes. After some of his experiments he noticed that certain pieces of chrome steel had not suffered from corrosive influences under conditions which would have rusted ordinary steel. He followed up this clue, and what is known as stainless steel was eventually worked out and added to Sheffield's metallurgical triumphs.—*Scientific American.*

Master Blacksmiths' Convention

Papers on Heat Treatment of Steel, Autogenous Welding, Spring Making and Shop Equipment

Methods of securing increased production in the shops and increasing the service secured from forgings were the principal topics discussed at the twenty-fifth convention of the International Railroad Master Blacksmiths' Association, held at the Hotel Sherman, Chicago, on August 19-21. The convention was opened with prayer and an address of welcome, following which the president, W. C. Scofield, delivered an address which reviewed briefly the developments since the last meeting in 1916.

PRESIDENT'S ADDRESS

Mr. Scofield said in part: In reviewing the great world conflict, our craft can with reasonable pride, look at the many monster guns, munitions and engines of war, and know that their ingenuity and brawn helped in making these mighty implements. In the present upheaval let us forget the fallacies of socialism, the ignorance of bolshevism, and the utter nonsense of the soviet, and return to the principles of our fathers and realize that the safety of our institutions, the success of country, and the happines of our home, depend not so much upon how much we can get, but upon how much we can do.

W. C. Scofield (Ill. Cent.)
President

J. Carruthers (D. M. & N.)
First Vice-President

G. P. White (M. K. & T.)
Second Vice-President

COST ACCOUNTING IN BLACKSMITH SHOPS

BY G. F. HINKINS
Westinghouse Air Brake Company

A paper touching on the history of the association and the duties and responsibilities of its members was submitted by G. F. Hinkins. In concluding his paper Mr. Hinkins made a plea for more thorough methods of computing the cost of work, which is given in part below:

As a rule, the foremen blacksmiths have every qualification for handling shop work. By that I mean that they possess executive and mechanical ability, but how many understand the fundamental principles on which their business is conducted? Of course, they can tell the flat labor cost of their product, but do they know the overhead expenses? This is a very complex proposition. The overhead for making a flat chisel is much less than the overhead for making an intricate drop-forging, by reason of the high first cost and upkeep of the dies. The overhead expense of producing different forgings varies in accordance with the nature and shape of the forging, as the shape of the forging will determine the cost of both the drop forging and trimming dies. Drop forgings on account of their shape and refinement will influence the life of the die. The maximum output from a set of dies will vary from 10,000 to 50,000. In order to get the cost of the product, it is necessary to get the first or original cost of the dies and also the number of times the dies are dressed before they are worn out and the number of forgings made from these dies. It will be perceived from the foregoing that everything that is necessary to produce a forging must enter into the cost of that forging.

There must be business methods for ascertaining the true cost of doing work, especially if manufacturing is being done for the market. If a furnace needs repairing and the brick mason helps himself to a load of fire brick to repair it and does not charge the brick against that furnace, then some part is not charged for something it did get and some other part is paying for something it did not get. The upkeep of the various types of equipment such as steam hammers, drop hammers and forging machines will differ and the expense for repairs must be kept separate which is done by charging such items against the individual machine. Every machine and furnace is designated with a shop or machine number so that all repairs and renewals are charged against the equipment. In this way, the cost of maintenance of every machine and furnace is known. This is a necessary feature of a cost accounting system which gives the cost of any manufactured article. You may manipulate your charges as you please, but you cannot get away from the cost. Your firm pays the bill.

DROP FORGING AND ITS POSSIBILITIES

BY J. D. BOYLE

The following is an abstract of the paper on this subject: Steel is not a simple substance like pure iron, gold or copper, but a complex artificial substance. It is composed of groupings of elements which enter into its makeup. These elements are only visible with the aid of a microscope. The term micro-structure has been given to what is thus brought to view. Upon polishing and etching a piece of steel the structure is apparent through the action of the etching medium, (acid or other corrosive materials) which affect the elements variously, causing each to assume a color or structure peculiar to itself.

When steel is heated above its critical point for the forging operation and submitted to blows under the hammer the molecules of the metal are forced apart. To bring the steel to its greatest maximum strength a proper scientific heat-treatment is needed. This is accomplished with proper furnaces, heat measuring instruments and trained workmen. With all the above-mentioned facilities, automatic signal pyrometers, well-designed cooling systems and semi-muffle furnaces designed for this purpose should be used. Heat-treating departments of this type are built to insure quality and progressive production. The materials going into the vital parts of a locomotive should be subjected to a chemical analysis and a heat-treatment applied. After heat-treatment, test specimens should be taken to determine the physical characteristics.

Discussion

H. E. Gamble (Penn.) told of the wide variety of work made under drop hammers. At the Juniata shops hammers ranging from 1,500 to 12,000 lb. are in use and the capacity of the largest size has been overtaxed. All reciprocating parts for locomotives are heat treated after they are drop forged. G. Fraser (A. T. & S. F.) stated that a steam hammer could be used for drop forge work by making dies similar to those used in the drop hammer. The dies are held in a box tool secured by a band and hung in the frame. Several members stated that this method was being used with satisfactory results. O. Schutze (C., M. & S. P.) told how drop forge dies had been adapted to use in a Bradley hammer for making spring hanger gibs. Ample clearance must be allowed to dispose of surplus material, otherwise the dies will have a short life. Attempts to make drop forgings under a hydraulic press had proved unsuccessful. There was some discussion regarding the best material for piston keys, and it was agreed that tire steel was the most satisfactory for this purpose.

REPAIRS TO LOCOMOTIVES FRAMES

BY P. T. LAVINDER
Norfolk & Western

Cast steel now having practically taken the place of wrought iron frames brings into the question of frame repairs a great many new features. The subject of repairs to an engine frame should be carefully considered from all sides. We should be governed by the results obtained by the most successful methods in repairing frames. The shops must be prepared to do this work in a quick, easy manner, keeping in mind at all times the safety of the employees. All the skilled help that is required to do this work must also be provided and the man in direct charge of, or the man doing this work, must be personally interested in it.

At the Roanoke shops of the Norfolk & Western, the following method of repairing frames is being used with great success: It was formerly the practice to use electric welding exclusively in repairing locomotive frames with the exception of welds made in the smith shop forge. In making electric welds the procedure was as follows: The frame was cut from both sides at angles of approximately 45 degrees. The frame was expanded from 3/32 in. to 5/32 in. depending on the size of the frame; using a portable grinder on the scarf where the weld was to be made, cleaning it to secure good bright metal. Welding was begun at the bottom of the scarf, one operator working on each side of the frame. Care was taken to keep the weld free from oxidization and scale as much as possible, by the use of a wire brush, and when the weld was completed it was annealed.

The Roanoke shop has made 19 oxy-acetylene welds on locomotive frames in the past 60 days. This is the first frame welding done at this shop by this process. No failures have been reported up to this time, and it is believed this method will prove very satisfactory. In making welds by the oxy-acetylene process on locomotive frames the following method is used: First, the frame is trammed over the break with a long tram, care being taken to use a tram long enough to keep clear of the heat. Second, the frame is cut from both sides in a V-shape at angles of 45 degrees. Third, the portable grinder is used on the scarf, where the weld is to be made, cleaning it to good bright metal. Fourth, the frame is spread for expansion allowing 1/4 in. to 9/32 in. according to the size of the frame. Some acetylene welders allow far less expansion than others, but we believe that a frame welded a little too long is much better than one too short. More expansion should be allowed when a furnace is used around the frame for preheating purposes. Fifth, the expansion blocks are covered with asbestos in case they are liable to get hot. Sixth, a piece of boiler plate is cut and placed under the frame at the location of the weld. Seventh, the frame is heated with a welding blow pipe or preheated with an oil burner. Eighth, welding is started at the bottom of the scarf, the operator on each side of the frame bringing the metal out to the desired thickness and proceeding up the scarf. This is necessary as a welder should never go back over a weld to apply more metal. When the weld is practically completed the spreader block is removed. This is necessary as the weld is getting shorter just as soon as welding stops. If a lower rail is to be contended with, it should be heated to a good cherry heat, thus allowing the top and bottom rails to contract evenly, removing all strains. Expansion and contraction must be governed by the welders, as some welders are faster workers than others. Frame welding, whether by the electric or oxy-acetylene process, should be done by the most competent operator available as the success of the work depends entirely upon the operator.

In conclusion I would recommend that when an engine comes into the shop for heavy repairs and the frames have been welded four or five times, the frame not having been taken from under the engine at the time the welds were made that the frame should be taken down and put in the smith shop. All welds previously made while the frame was under the engine should then be cut out and worked over and the frame made to proper dimensions. One leg of every brace should then be heated midway between the top and bottom of the rail to a red heat. By this method all strains in the frame that have been caused by welding or otherwise will be released.

Discussion

There was a prolonged controversy regarding the best methods for expanding frames preparatory to welding. Some stated that the bottom rail should never be heated to secure expansion in the top rail, as it was unnecessary and caused the rail to shorten. G. W. Grady (C. & N. W.) criticized the practice of welding from the bottom of rail due to the uneven heating of the section. He advocated welding out from the center to keep the same heat at the top and bottom of the rail. Good results have been secured by this method without annealing after the weld is completed.

PURPOSES AND RESULTS OF THE HEAT-TREATMENT OF IRON AND STEEL

BY GEORGE HUTTON
New York Central

Heat treatment as pertaining to railroad work in railroad shops seems to have gone backward during the past three or four years. When first introduced on locomotive work it was thought this method was going to create a great improvement in the quality of forgings over the hit or miss method. The method in vogue today is for the forge shop to construct the different forgings and send them to the various departments to be machined to size and then applied to the locomotive without any record or any means of knowing if these forgings are of equal strength or of uniform quality.

These are the existing conditions today. In forging side rods, piston rods, rod straps or any piece of work that may be important, you endeavor to have these forgings made up by the best workmen you may have, and to exercise great care in heating and hammering them. You may also be cautioned, and caution your men to have them carefully annealed and laid on the floor stacked in such a way as to cool off equally, so that machining may be best accomplished. When you have carefully looked after this you have forgings that will only stand up to a strain equal to the strength of annealed material. Remember, annealing weakens forgings.

You will remember when vanadium steel was introduced in railroad work about the time when heat-treatment was also introduced or brought into shop practice. Why was heat-treatment confined to the alloy steel only? The steel makers furnished a steel which, if no heat-treatment was applied, would not be any better or any different from the annealed open-hearth steel, generally in use before the time of alloys or the open hearth in use today.

You have, no doubt, noted the breakage of alloy steel forgings that may have come to your shop off the road that had been heat-treated, and I am positive in my opinion that your verdict was, "Too hard; brittle; too hot when quenched; not drawn back enough," and this is exactly what has set back or almost killed the wonderful results of heat-treatment especially on alloy steel. The average result of this method has been a sacrifice of elasticity for tensile strength. I am of the opinion that when the alloy steel was introduced it was never meant that forgings should be treated to such an extent that breakage was the natural result, but certainly this has been the case.

During the 1915 convention in the discussion on heat-treatment, one member remarked that if we make our forgings, get the proper heat and proper hammering we would have much better forgings than any of the heat-treated ones. If we could only attain efficiency of that kind the whole problem would be solved. But who are the craftsmen who could do it and put it in effect in all our smith shops? There is too much left to guesswork when that method is compared to heat-treatment. When heat-treatment was introduced the main object was to get strength, durability and uniformity, and also to reduce the weight of forgings and castings, and to a great extent this has been accomplished with the exception of securing uniformity, and that is what we are trying to attain with this method.

Heat-treatment of locomotive forgings is a very different practice in comparison with heat-treatment on automobiles or trucks or any light forgings in other industries. We must all admit that the automobile builders have been successful. It has been proved that we can get the desired strength and also the endurance test on some forgings, and several shops have been very successful on all forgings they have heat-treated, but failure has been the result in the majority of shops. I believe it has come about through the fact that all the experiments were on alloy steel only. The greatest trouble is to attain uniformity in heavy forgings. Aside from all the discouraging features of heat-treatment that are found in the average railroad shop, I believe it is a method we should all endeavor to learn more about.

There are many obstacles which are detrimental to successful heat-treatment of locomotive forgings in railroad shops. There is the cumbersome equipment and space which is essential to success. There are very few shops that could readily be prepared to treat even the lightest of forgings. Then there is the output to be considered and the extra help required. But considering all the obstacles and expensive equipment I believe it would prove a good investment when the method was thoroughly understood.

If heat-treatment was introduced in your shop, what would your opinion be, for or against it? If heat-treatment was introduced in your shop, what effect would it have on your output? What extra help would you require? What extra time would you require (if any) to complete a set of rod straps complete, heat-treated? These are questions that we should be interested in and may be asked any time regarding this method. I would like to hear the opinion of different members on this subject. I am sure there are a number of shops that have tried it out to some extent.

Discussion

There was considerable difference of opinion regarding the advantages secured by heat-treatment. H. E. Gamble (Penn.) stated that in addition to improving the quality of the steel, heat-treatment brought out defects. G. Fraser (A., T. & S. F.) stated that he considered annealing preferable to heat-treatment. While heat-treated parts showed high tensile strength they seemed to break down under the vibration to which they are subjected in actual service. W. C. Scofield (I. C.) attributed much of the trouble experienced in using heat-treated parts to the unequal rate of cooling in light and heavy sections. Large forgings are heated above the critical temperature, to treat the material in the interior of the section, and are then quenched again at a lower temperature to take care of the outer layer. Mr. Scofield thought that the high temperature might do more harm than good, and suggested that this explained why small parts have given splendid service after heat-treatment, while larger parts have often failed. George Hutton (N. Y. C.) stated that the New York Central has heat-treated material for three years, and he had still to hear of a single failure. A motion was adopted stating that it was the sense of the convention that wherever heat-treatment can be done it is a success.

SPRING MAKING AND REPAIRING

BY J. W. RUSSELL
Pennsylvania

The question of springs for locomotives in any up-to-date repair shop is one of the most important items that we have to consider because if the proper methods are not used the making and repairing of springs becomes a very expensive proposition. There are so many different ways in which the spring plant may be utilized for economy or waste, that it is incumbent upon the man in charge to put forth every effort in order to obtain the most desirable method. In the first place, we should use all the machinery possible in this class of work, because of the resultant speed and accuracy. The use, also, of all scrap steel that has not deteriorated to any great extent from re-working is economy. The plates should be annealed and cut to desired length; the long plates cut for short ones, and they in turn formed into spring clips, etc. Care must be exercised in examining and selecting this scrap steel in order to avoid reclaiming into service plates that are checked or cracked.

At Renova shop we have followed the method as outlined above and have obtained very good results. We do the spring work for the entire grand division, which requires an output of approximately 400 springs per month. Our new steel is purchased under Pennsylvania Railroad specifications of .90 to 1.15 carbon. We shear the plates to length and cut off the corners cold on a No. 7 Hilles and Jones shear, located in the smith shop, after which the material is delivered to the spring plant where the nibbing, cambering, hardening, drawing, banding and testing are done. We use oil for fuel in all operations except drawing, which operation is done by the use of sodium nitrate. We find that sodium nitrate will stand a heat up to 1,000 deg. F., at which point we draw all our heavy plates for one hour. The lighter plates are drawn at 900 deg. F. for 45 minutes. Incidentally, I might mention that we found it necessary (when using the sodium nitrate treatment for drawing these plates) to plunge the hot plate into a bath of water to remove the sodium nitrate that adheres to it.

The following table is used by us in heat treating springs,

Temperature of Bath and Time Required to Heat Treat Springs

Size of plates	Deg. F.	Time in bath, minutes
4½ in. by ⅜ in.	925	45
4½ in. by 7/16 in.	925	60
4½ in. by ½ in.	990	60
3½ in. by 7/16 in.	900	45
5 in. by ½ in.	950	60
5 in. by ⅝ in.	1,000	60
6 in. by ½ in.	950	60
4 in. by ⅜ in.	925	45
6 in. by 7/16 in.	950	60
3½ in. by ⅜ in.	925	45
3½ in. by ¼ in.	900	30
5 in. by ⅜ in.	925	45
3 in. by ½ in.	950	60
3 in. by 7/16 in.	950	45

after which is given a tabulated statement showing the transverse test of individual plates, giving the deflection and breaking angles.

In order to make the transverse test, one plate is taken from each heat and submitted to the test, using the span and deflection shown on table for that particular thickness

Specifications for Transverse Test of Spring Leaves.

Thickness of steel	Transverse span to be used	Deflection test in 100ths of an in.	Breakage test minimum angle of breakage, deg.
¼ in.	18 in.	104	63
5/16 in.	18 in.	83	50
⅜ in.	18 in.	69	42
7/16 in.	24 in.	114	36
½ in.	24 in.	93	31
9/16 in.	24 in.	82	28
⅝ in.	24 in.	74	25

of leaf, and if the leaf does not take a permanent set of more than .02 in., it has an elastice limit of not less than 120,000 lb. per sq. in. and is then broken. If it breaks at an angle not less than that shown on the table for that thickness of leaf, it is accepted.

The next operation is assembling and banding. We use a hydraulic assembling machine in connection with the hydraulic banding machine, having a pressure of 1,500 lb. per sq. in. After the band is applied, the spring is placed in such a position that a stream of water cools off the band. The spring is then tested, and if found all right is dipped into the paint vat and placed in storage. Our furnaces are equipped with the Stupokoff pyrometers, using the platinum, platinum-rhodium couples. These pyrometers are checked once each month against a standard test pyrometer, which instrument is checked against a laboratory pyrometer.

DISCUSSION

Several members expressed the opinion that spring making was carelessly handled in many shops. The part of the work which is most often neglected is drawing the temper, although uneven heating and cooling when hardening is not uncommon. J. W. Russell (Penn.) stated that the use of strong bands on trailer springs had been found advisable. The application of rollers between the band and the spring seat also added to the life of springs. Good fitting is essential and wide openings between the leaves were condemned as detrimental to strength.

AN UP-TO-DATE RAILROAD BLACKSMITH SHOP

BY GEORGE FRASER
A. T. & S. F.

The location of the blacksmith shop is an essential feature not only as it influences the design and arrangement of the building and the layout of the tools, hammers, forges, etc., but also as affecting the output of the shop. The nature of the work and the conditions surrounding it require the building to be in an isolated location in order to provide light and air on all sides. In repair work much material travels from the erecting and assembling shop to the blacksmith shop and back again, especially in locomotive work. A large proportion of the material passing between the locomotive and blacksmith shop is heavy and bulky. For this reason the blacksmith shop should be so situated in relation to the locomotive department as to provide for movement over the shortest and most direct route. Such material is usually transported on push cars and trucks so that distances are important in economizing time and increasing output.

From the standpoint of shop production, the blacksmith shop is looked upon as a feeder for other shops of prime importance. Sometimes this is overlooked in preparing the original plans, and the average blacksmith foreman is never consulted with regard to them, so when the shop is completed he is invited into it, and it is up to him from then on to make the best of it.

The blacksmith shops at the principal shop plants of the large railway systems turn out the forgings entering into the construction of new cars, and the bulk of the car forgings required in keeping up the repairs of both freight and passenger car equipment on the line, as well as the forgings for locomotive repairs. As there is a difference in the nature of the work for the two departments, each should occupy a section common to itself, and the machines, forges and equipment should be arranged accordingly. Naturally the equipment for each department is situated in that portion of the blacksmith shop building nearest to the principal shop which it serves. A ground plan in the shape of the letter L is a convenient arrangement for the blacksmith shop, accessible to both the locomotive and car departments. The many conditions affecting the demands upon the blacksmith shop and the differences in the dimensions of the shops on the various railway systems render it impractical to attempt to give a definite proportion based upon any given unit.

The introduction of cast steel in many details for which forgings were formerly used almost entirely has affected the necessary size of the blacksmith shop so far as the locomotive department is concerned. The increased scope of forging machines assisted by the extended use of formers and dies for rapidly duplicating standard parts of cars has increased the possible output of car forgings without enlarging the area required by the shop building.

A general practice has been to span the entire floor without providing intermediate supports for the roof trusses, and in a number of cases this distance equals 100 ft. The trusses are usually supported by the side walls which carry the weight of the roof structure and roof. At Topeka the steel skeleton is entirely independent and the roof structure is carried by built-up columns to which the walls are secured to provide stability. The roof trusses span a distance of 100 ft. The elimination of supporting columns and the long span of roofed trusses without intermediate support allow free scope in the distribution of equipment on the floor. The method of handling heavy work in the blacksmith shop by means of swinging jib cranes requires freedom of action for the crane arms and the absence of obstructions facilitates the arrangement of these cranes. The long span of roof trusses, together with the requirement of a stiff frame construction to withstand the additional load imposed by supporting the upper ends of the crane column, calls for heavy parts and careful design of the roof structure. The horizontal loads imposed by the swinging shop cranes requires stiff lateral bracing. While the distance from the floor to roof trusses at some of the older shops is about 20 ft., the height of the more modern shop has been increased to 30 ft.

Almost without exception, the floor of the blacksmith shop is of earth of some kind. This is frequently covered with a coating of cinders well tamped, and by all means it should be raised 6 in. higher than the level of the ground surrounding the shops.

The ventilation necessary in a blacksmith shop and the amount of natural light needed require a high free space not only to allow the smoke and gas to rise away from the floors and forges, but to permit the diffusion of light from long windows. It is a very noticeable fact that the cleanest, brightest, most airy blacksmith shops are those with high walls. The roof of the blacksmith shop is usually surmounted by a wide monitor extending nearly the entire length of the roof. This is provided for the sake of ventilation rather than to distribute light. The windows in the walls are depended upon principally for natural light, and it is generally considered that the window area should equal at least 60 per cent of the wall area. In order to offer the least obstruction to the free circulation of air throughout the shop in warm weather and in warm climates the windows should be hung on pivots to provide a greater opening than raising and lowering of sashes.

In addition, the shops should be provided with rolling doors and the lay of the shop should be east and west with an open space clear from other buildings on the south side so that all alike will share the south breeze in hot weather. An arrangement frequently followed in the construction of the monitor is to alternate the windows along the sides with space having wooden slats built in on an angle, thus permitting the free circulation of air while excluding rain and snow.

The removal of smoke and gases from the forges is provided for by different methods. Experience in some shops where great care was used in their design to provide for efficient ventilation is said to have proved that smoke hoods in high shops are unnecessary and that the interior of the building is clear and free from smoke and gas at all times.

Hand forges are usually arranged in a row along the wall conveniently placed according to the class of work which they serve. The distance between centers of forges varies from 16 to 20 ft. and 5 ft. from the wall. Forges are arranged at a uniform height of about 24 in. and should be of uniform shape and size.

Careful provisions for tool racks is a necessary detail not to be overlooked, for the care and maintenance of tools and equipment is the duty of the energetic foreman. Tool racks are generally arranged along the wall of the shop and in the center of the shop. For hammer tools, etc., a revolving cone shape tool rack may be provided.

Oil is the most common fuel used in blacksmith shop furnaces. In latter years it has rapidly displaced coal and coke, not only proving more satisfactory and economical as fuel, but also improving the appearance of the shop by removing the necessity of the unsightly coal and coke boxes about the shop. It has been demonstrated by practice that with oil as fuel it is possible to obtain a larger output, a better grade of work by the greater intensity of heat as well as more even heat, the elimination of the necessity of attending the fires, the shortening of the time required to bring the furnace to the desired working temperature and improvements in the conditions under which furnace men work. It is a noticeable fact that in a majority of the new shops particular attention has been paid to the furnace equipment, the design of the furnaces for the various machines and their location in relation to the machine and the movement of the material.

The location of large scrap furnaces should be on the outside of the shop with the working side of the furnace flush with the inside of the main wall. To avoid any possible shortage of steam, boilers should be installed over all large scrap and forging furnaces. By this plan no fuel expense is chargeable to producing steam as the flame and gas from the furnaces do the work.

In arranging the fire and furnaces, they should be so placed that the men are not too near a furnace or fire when working on the metal. Efficiency engineers will figure on the number of steps that can be saved in handling from the fire or furnace to the hammer, or anvil, overlooking entirely the comfort of the men whose vitality is sapped by having the fires too close to the anvil or hammer. The arrangement of furnaces, anvils, hammers and machines should be left to the judgment of a practical man, one who is acquainted with shop practice and who is in charge of smith shops.

No part of the general railroad repair plant has undergone a greater change during the past 10 or 15 years than the blacksmith shop. A few years ago the majority of work passing through that shop was done on open fires and a large quantity of the new material was purchased from manufacturing concerns; today, due to the introduction of forging machines, the majority of work in the modern shop is, or should be, machine work.

Modern machines without proper die equipment are of little value. The main blacksmith shop should be provided with its own tool room where the die work could be carried along independent of the locomotive department, thus avoiding delays. Little attention is given by other departments in assisting foremen blacksmiths along these lines. The following equipment is sufficient for the average shop: one each, planer, shaper, lathe, drill press and face plate. This equipment is installed in the blacksmith shop tool room at Topeka, and greatly facilitates tbe work of getting out dies for the blacksmith shop.

In connection with furnace equipment and open fires, particular attention should be paid to the layout of blast piping. Efficient blast is a very important consideration to the blacksmith shop as it practically governs the heating capacity not only of furnaces but of the open fires. The blast line should be overhead and the safety valves should be provided in the up and down line leading to the forges to take care of any gas that may possibly enter the blast line.

The main blast line should be reduced in area in proportion to the distance covered so as to maintain a good pressure at the end of the line. When compressed air is used in addition to the blast to atomize fuel oil an eight ounce blast is sufficient. When fan blast alone is used nothing short of ten ounces will give satisfactory results. The exhaust pipes on steam hammers should pass downward through an independent pipe suitable to carry the exhaust beyond the shop into a catch basin.

The modern shop may have all the facilities it is possible to provide and still not get results. The foreman in charge must have the good will and hearty co-operation of each and every man under him to reach the maximum of efficiency.

DISCUSSION

The ideas presented in Mr. Fraser's paper were endorsed by the members who agreed that the arrangement outlined was practically ideal. W. J. Mayer (M. C.) questioned the advisability of restricting the exhaust from the steam hammers, and asked whether any plants used the exhaust for heating. Several plans for using the steam were described. In some cases a butterfly valve is used in the exhaust steam line to limit the pressure. At the West Albany shop of the New York Central the exhaust from the hammers is piped to the heating system and no heat is required in any part of the plant other than that furnished by the exhaust steam. A similar arrangement is used on the St. Louis-San Francisco at Springfield, Mo. The advantage of piping the exhaust down to prevent condensation injuring the packing and dripping on the dies was brought out by several who spoke.

RECLAIMING SCRAP IN THE RAILROAD SHOP

BY WALTER CONSTANCE
St. L. & S. F.

Although the subject of the paper I am to present includes scrap reclaiming by the use of oxy-acetylene and electric cutting and welding process, electric welding is not in use at our reclamation plant, and I will have to leave the discussion of electric welding in relation to reclamation to others.

We use the oxy-acetylene torch in stripping frogs, switches, etc. We save good filler blocks, reinforcement and similar parts to use again. We furnish over 50 per cent of all switch material used on the system. Switch frogs, switch stands, switch rods and plates are reclaimed or repaired. Brace or slide plates are made from old Weber joints and scrap boiler steel, also transit clips for switch points from scrap steel.

We have also made up quite a number of oil tanks from tank cars which have been burned. These are cut up by the torch and the best of the steel is sent to the boiler shops for use. The rest is cut up under shears to make switch material and repair parts for steel frame cars. Old cisterns for locomotive tenders are cut up and used to make loading platform running boards, and coal car corner bands. Good parts of scrap steel cars are used for the same purpose. Some of our brake beam stripping is done by the oxy-acetylene torch.

We formerly welded quite a number of bolsters and baggage wagons and warehouse trucks. Oxy-acetylene welding comes in handy on these things, especially for repairing steel warehouse trucks, the frames of which are broken, as it does not pay to repair them in the blacksmith shop when they have to be stripped, but by oxy-acetylene welding they can be made serviceable again at small cost without stripping them.

We formerly welded quite a number of bolsters and truck frames as well as broken couplers at this plant, but of course we have discontinued doing so now. However, we are changing a large number of good couplers with 5 in. by 5 in. shank, 6½ in. butt, to 5 in. by 7 in. shank and 9⅛ in. butt. This is done by welding tapered slabs of steel on the shanks and blocks upon the butts. These then conform to M. C. B. dimensions.

We also reclaim a number of derailing frogs, which are for smaller rails than our standard 90-lb. by splitting them and inserting a piece in the side and welding up with oxy-acetylene so as to bring them to the proper height for the larger rail.

There are no rolls at our plant, but all second-hand bolts are used by cutting off and re-threading, and nuts by re-tapping. Also all flat iron and round bars are saved for use. Bottom rods are made with solid jaws from old 1½-in. A. C. rods, dump rods, and so on. Truss rods 1¼ in. in diameter are made into brake stuff. The short pieces left over are made into brake beam truss rods, bolts and coupler rivets. Other sizes of rounds are used for handholds, bolts, etc. Rusty ¾ in. and ⅞ in. steel is rolled into brake shoe keys on an abandoned spring roll. Rusty and pitted rounds 1⅛ in., 1¼ in. and 1⅜ in. are made into grade stakes for the engineering department. All lined iron is rattled and made into frog bolts and switch chain links. We make standard 1 3/32-in. brake pins by upsetting one-inch iron on the forging machine.

All brake beam repairing on the system is done at this plant. We use an air bulldozer for straightening. All beams are stripped by laborers, and are re-assembled by blacksmiths and helpers.

All round iron and bolts are straightened under air hammers at the scrap docks. The bolts are sheared to length and sent to the threader and the iron is sheared for heading in the blacksmith shop. All serviceable track spikes are also straightened at the yard shop.

Coil springs that are standard are reset. Scrap springs are uncoiled on a special machine and made into lining bars, jack bars, rock drills and drift pins.

All track tools on the system are sent here for repairs. Worn claw bars are made into engine pinch bars and lining bars. Picks are welded if they have one end long enough to sharpen. Where both ends are to be welded it does not pay to repair them. Short picks are heated and cut off to obtain steel for welding out others. We also make new claw bars, lining bars and tamping bars from scrap tire steel. All blacksmith's tools are made from tire steel and we also use tire steel for the manufacture of bolt dies and hammer tools.

Crooked angle bars for small sized rails are straightened in tools under the steam hammer. This tool spreads the bars slightly and makes them serviceable for siding and commercial tracks.

All coupler yokes are stripped at this plant under a power shear. Yokes are repaired when possible and scrap yokes are used to obtain iron for the forging furnace.

Brake levers that are not standard are re-punched, cold plugged and returned to service. Old sill steps are used to make running board brackets, pipe clamps, etc. All car material, such as brake rods, brake hangers, brake staffs and fulcrums which are repairable are sorted at the scrap docks and repaired in the blacksmith shop.

A very close check is kept on the costs, and if a good margin of profit is not shown we do not attempt to repair and reclaim. The welding and cutting apparatus is here to stay because we make a specialty of repairing or reclaiming, whereas that is only a side line in ordinary shops and naturally not so successful.

DISCUSSION

C. E. Stone (D., L. & W.) told of the good results secured by re-rolling scrap bars. G. Fraser (A., T. & S. F.) brought out the advantages of reclaiming as much material as possible at the shop where it originates. He also called attention to the necessity for careful consideration of the work done in order to avoid reclaiming where it is more expensive than the purchase of new material.

HEAT-TREATING

BY H. E. GAMBLE
Pennsylvania

Of late years there has been a marked advancement in the art of heat-treating parts incidental to locomotive and car construction and maintenance. In making the forgings, the billets are cold throughout before being heated to the forging temperature. The finishing temperature, the rate of heat advancement and the capacity of the hammer used are of great importance in forging the different parts. After forging, the parts are first thoroughly annealed to relieve the strains set up in forging. They are then heated and quenched in oil or water. From there they are placed in the drawing back furnace, where they are tempered. The steel used in making these forgings is covered by specifications which call for a carbon content of from .40 per cent to .55 per cent. The quenching and drawing back temperatures are governed by the per cent of carbon contained in the steel. The physical requirements of the heat-treated forgings are determined by the specified diameter or thickness which governs the size of the prolongation from which the test specimen is secured. It should be taken at a point midway between the center and outside of the forging in the direction in which the metal is most drawn out in the forging process.

Each forging must have the manufacturer's mark, melt number and year in which made stamped on as a means of following up the treatment in case of failure in service. It is most important to give all forgings a thorough annealing to relieve the strains set up during the forging operations to insure a good treatment. Furnaces properly charged and forgings heated thoroughly will give the best results. We are reclaiming all main and side rods that are free from fractures, that have been bent, twisted, upset and stretched while in service, thus doing our bit to help the repairing of locomotives along by saving steel, time and labor. These rods are made correct to a template by the blacksmith, allowing for the proper shrinkage. They are then taken to our heat-treating plant, giving them the proper annealing, quench heating, quenching and drawing back. They are then returned to the blacksmith for final inspection and are then ready for service. In reclaiming rods for service, it is necessary to have blacksmiths who are interested and careful in their heating and workmanship. The reclamation, reforming and subsequent heat-treating of many parts which heretofore were scrapped, is one item that will pay the entire cost of heat-treatment alone, not to mention the saving effected along other lines.

POWDERED COAL FOR FURNACE HEATING IN SMITH SHOP

BY H. E. GAMBLE

In handling producer gas and oil furnaces for forging heavy locomotive parts, drop forging, heat-treating and bolt making, the question arises whether a change to powdered coal would be warranted on account of the low cost in operating. In connection with experiments on mixing crude oil with powdered coal, this might help to use up heavy grades of fuel oil coming into the markets for heating purposes. Coal in a finely divided or powdered state represents the most advanced method for producing perfect combustion, making it possible to more nearly obtain the full heat value of the fuel than by any other known means. The generally recognized waste, unstaple or otherwise low-value coal mine products are suitable for converting into the powdered form. To give the best results as regards complete combustion and the least trouble as regards ash and slag, it is very necessary to have powdered fuel dry and keep approximately 48 hours' supply on hand to prevent the possibility of the coal absorbing too much moisture. The statement has been made that it is not necessary to build new furnaces, as by a slight change present equipment can be made to handle powdered coal. Coal rich in volatile matter is preferred, slack or screenings in preference to run of mine. To successfully burn powdered coal, it should be uniformly fine. The maintenance of a correct ratio of air to coal is absolutely necessary, as on this depends the ability to hold an unwavering and uniform temperature in the furnace, which ranges up to 2,200 deg. F.

We have unquestionably passed through one of the greatest fuel conservation periods known, and the members of this association should do all in their power to secure the best equipment and use their good judgment in conserving all fuel possible in running the blacksmith shops.

OTHER BUSINESS

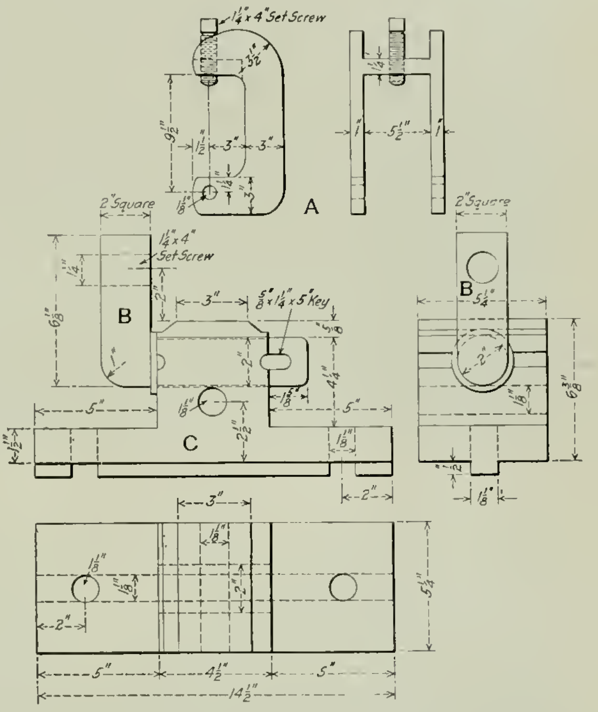
The report of the secretary-treasurer showed a total membership of 375 and a balance of $741 in the treasury. A committee was appointed to confer with the officers of the American Railroad Association regarding amalgamation with Section III, Mechanical.

The following officers were elected: President, J. Carruthers (D., M. & N.); first vice-president, W. J. Mayer (M. C.); second vice-president, Joseph Grine (N. Y. C.); secretary-treasurer, A. L. Woodworth (B. & O.). In the balloting for the location of the next convention Birmingham, Ala., received the largest number of votes.

A TIRE CLAMP FOR BORING MILLS

BY H. L. LINGO

A clamp for a boring mill, so designed as to permit the boring and turning of a tire at one setting, is shown in the drawing. A complete set consists of four of these clamps; all of the parts shown and the necessary keys and set screws are made of steel. To set up a tire on the mill ready for boring, the blocks *C* are secured to the table at the proper points for the diameter of the tire to be bored. The tire is placed on the blocks and the clamps *B* inserted through the block, on the outside of the tire, and then keyed in position through the slot shown in the drawing. A 1¼-in. set screw in the square portion of each of the clamps *B* provides a



Details of the Block and Clamps

means of securing the tire firmly and accurately in place. When the boring is finished the clamps *A* are placed over the blocks *C* so that the 1⅛-in. holes in the clamp coincide with cross-wise holes in the block, and a pin or key is inserted. The upper portion of the clamps *A* are directly over the tire and the 1¼-in. set screws are tightened against the tire, holding it firmly to the block. The clamps *B* are then removed and the tire being secured by the clamps *A*, may be turned without resetting.

This method is very useful in a shop turning out extra tires of varying diameters and tread thicknesses for replacement of worn tires at other points on the road, and can also be used with equally good results in turning new tires.

THE LUMBER FREIGHT BILL.—The annual freight bill of the lumber industry is estimated at about $215,000,000. Lumber and forest products furnish about 11 per cent of the total tonnage of the American railroads or about 215,000,000 tons yearly, according to Interstate Commerce Commission statistics. This is greater than the movement of all agricultural products and is exceeded only by the tonnage of general manufacturers and mine products.

British Army Locomotive Repairs

Story of the Military Shops Near Rouen, France, Equipped and Operated by the Royal Engineers

BY H. L. COLE
Lieutenant Colonel, R. E.

THE shops shown herewith in various stages of their construction and equipment were used by the British Transportation Service for locomotive repairs during the last two years of the war.

The project is located near Rouen and was commenced by the French State Railway in 1912, but only partially erected when, in 1914, war broke out and interrupted the work. By arrangement with the French, the British Royal Engineers, Transportation Branch, took over the uncompleted shops in February, 1917, finished and equipped them, and continued to use them for the repair of the British, American, Canadian and Belgian standard gage locomotives in use by the British Expeditionary Force, until after the armistice was signed.

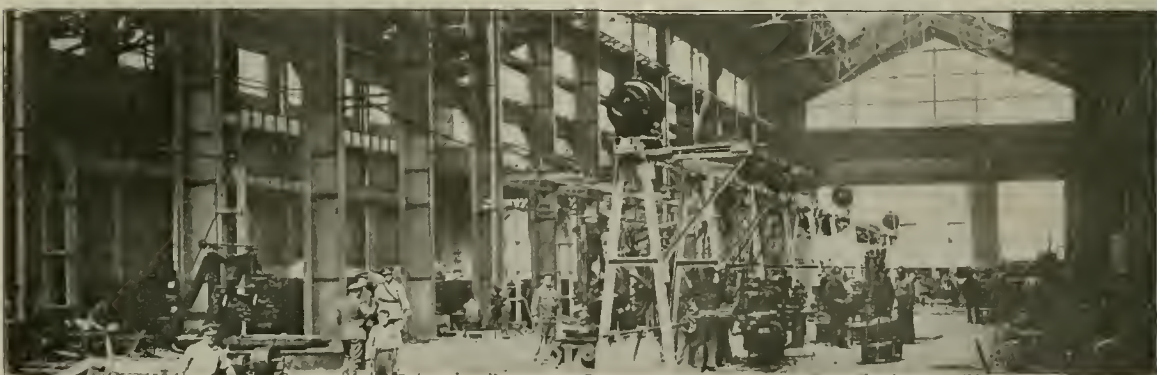
Within half a mile of the shops the sappers built their standing camp, the living huts being 16-ft. by 66-ft. demountable structures, to a standard and very economical design. A large proportion of the camp was built of packing-case timber, stripped off imported locomotive parts and run through an improvised saw mill on the site.

Near the main shops, but outside the main shop yard, the Royal Engineers built and equipped a pattern shop and brass and iron foundries, which turned out castings as large as locomotive cylinders on occasions, but normally supplied all common renewals requisite for locomotive casualties and fair repairs.

The corrugated cupola shown in one of the photographs was improvised out of a collapsed Fox corrugated furnace, bought as scrap-iron from a French junk-shop and rushed up to increase much needed output at a time of stress. Another was added later. Each gave approximately two (British) tons an hour, with a coke consumption between 4 and 5 cwts. per ton of fettled castings.

To appreciate the actual output of erected and repaired locomotives, it should perhaps be mentioned that the scheme was only mooted in December, 1916. On December 18 the first officer was appointed, on the 19th the site was inspected; on Christmas Day, the machine tool and equipment estimates were put up for approval and detailed lay-out plans were in

British Expeditionary Force Base Locomotive Repair Shops Near Rouen, France, As They Appeared in March, 1917; the Erection of the Outside Bay on the Left Was Started in February, 1917



Erecting Shop, Partly Completed, in August, 1917, With Canadian Built Locomotives in Course of Erection; Cranes of Eight Tons Capacity are Shown on the Lower Runway, Heavy Cranes Not Being Installed On the Upper Runway till February, 1918 hand. However, it was not till February, 1917, that the first small draft could commence work on the site, and the machinery and equipment arrived but slowly.

Both camp and works were built and fitted up by the men who had to use them. These were skilled men of all the necessary locomotive workshop trades. Half of the officers and men had fought in the front line, over a hundred had been through the Mons retreat or later operations entitling them to the 1914 Star and very many carried wound stripes.

The power plant, ordered in March, 1917, was placed in operation on October 4, 1917; but prior to that several machines were got going with temporary drives from small internal combustion engines. Over 30 (British) tons of iron castings were produced in a small emergency foundry before the power-house was working. The fan was driven at one time by a jacked-up Ford car, but mostly by a venerable portable steam engine, salvaged from a scrap-heap.

By the end of 1917, however, the establishment was up to

Machine Shop During Installation of Machine Tools, September, 1917

There were officers and men from India, China, South Africa, South America and Australia; and numbers of others who had never been outside the Old Country before the war. There was nothing of trades union restriction about these men. Machinists, blacksmiths, boilermakers, pattern-makers or moulders, dug and mixed concrete for foundations, built

strength and the shops almost in full swing. There had been 135 locomotives erected and a start had been made with heavy —some very heavy—repairs.

Up to the end of December, 1918, 232 new locomotives were erected and 370 engines were repaired, 2,073 pairs of wheels were turned up and 275 wheels re-tired, 737 tons of

The Foundry as it Appeared in December, 1917; Note the Cupola Built Out of a Corrugated Furnace

huts, erected shops, rigged derricks or did the next job that had to be done, whatever it might be.

The erection of engines imported from Canada and the United States was commenced almost as soon as the machine tool equipment began to arrive and months before the cranes were up, and proceeded simultaneously with the building and internal preparation of the shops. The first two engines were turned out together early in July, 1917.

forgings were turned out, 2,186 tons of iron castings and 168 tons of brass. The average output for 1918 is shown in the table.

Throughout the operation of the shops the work was gravely handicapped by the extraordinary variety of engines to be dealt with, the exceptionally bad condition of many that had worked for years without a good repair, the paucity of working drawings and the impossibility of either obtaining or maintaining good stocks of spares, or of getting them rapidly from England or America. Not the least of the handicaps were the natural corollaries to war conditions; an abnormally high proportion of serious defects due to rough track, rough handling and rough working conditions. For example, of the first 300 engines repaired, 15 had burnt fireboxes. One engine, a six-coupled inside cylinder type, arrived with her boiler-barrel pierced clean through and her motions wrecked by an aerial bomb. Cracked cylinders, bent and cracked frames, and chewed-up front or trailing ends due to collisions or other roadside adventures flowed in erratically, at times, especially during the great German effort in March-April, 1918, in abnormally high proportions.

The spirit and discipline of the men were well shown when, instead of being told that the strain could be eased off after the armistice, they were called upon to slam into their work again for all they were worth, in order to cope with the increased strain necessarily thrown on the transportation services due to the general advance of the Allied armies. Their average out-turn of repaired engines per week from the date of the signing of the armistice till December 31, 1918, was 8.8.

The average time the engines were detained in the shops during 1918 was 30 days per engine, including trial. The average man-hours expended per engine, excluding spares

Average Output of British Army Locomotive Repair Shops Near Rouen in 1918

	Number per week
Engines repaired	7
Wheels turned up, pairs	38.4
Wheels re-tired	5.4
Forgings, tons	12.8
Iron castings, tons	37.9
Brass castings, tons	2.8

drawn from stock, amounted to 3,418 for engine and boiler (including 655 for boilermakers) and 643 for the tender; total, 4,061 man-hours per engine complete for the road. The figures cover direct charges only and do not include time required for patterns and castings.

A planning department was maintained and the work was scheduled and routed through the shops. Several forms were used for routing, to suit the different types of locomotives handled and the different classes of repairs. A typical form, for heavy repairs to a locomotive with outside cylinders and valve chests, including renewal of boiler and cylinders, is shown in one of the cuts.

ROUTING SCHEDULE

ENGINE NO. CLASS REPAIR CLASSIFICATION

OPERATION (ERECTING SHOP)	Date routed	Actl date
Engine in shop, stripping begun		
Off wheels, wheels to wheel shop		
All parts delivered to Bosh.		
Boxes back to engine for gages		
Final inspection and orders		
Boiler out		
Cylinders off, S		
Stripping completed		

EX STORES AND BLACK SHOPS	Date routed	Actl date
Cylinders (from stock) to E.S.		
Hornblocks, clips, wedges		
Slidebars		
Axleboxes and details		
Crossheads, slippers & gudgeon pins		
Pistons, rods and details		
Motion and reverse gear details		
Brake cylinders and details		
Boiler mountings		
Vacuum, steam or air brake details		
Valves, spindles and fittings		
Connecting rod details		
Spring gear		
Piston and valve glands and packing		
Brake gear		
Sanding gear		
Frame details (buffer, couplings,etc.)		
Smokebox steam and blast pipes		
Coupling rod details		
Cab details		

EX FITTING SHOP TO ERECTING SHOP	Date routed	Actl date
Hornblocks, clips and wedges		
Slidebars		
Axleboxes and fittings		
Crossheads, slippers & gudgeon pins		
Pistons, rods and details		
Wheels		
Motion and reverse gear		
Brake cylinders and details		
Boiler mountings		
Air, vacuum or steam brake fittings		
Springs and gear		
Brake gear		
Piston and valve glands and packing		
Valves, spindles and fittings		
Sanding gear details		
Smokebox steam and blast pipes		
Coupling rods		
Frame details (buffers, couplings,etc.)		
Connecting rods		
Cab details		

OPERATION (ERECTING SHOP)	Date routed	Actl date
New cylinders bolted to frame		
Boiler in (ex stock)		
Lines up		
Slidebars up		
Hornblocks faced		
Crossheads and slippers fitted		
Pistons in		
Axleboxes fitted to frames		
Reversing gear up		
Motion hung		
Brake cylinders up		
Buffer beam on		
Boiler clothing fitted		
Axleboxes fitted to wheels		
Springs and gear up		
Engine wheeled		
Motion up		
Brake gear up		
Coupling rods up		
Boiler mountings		
Steam, vacuum or air brake ftgs. up		
Valves fitted		
Off pit		
Connecting rods up		
Sandboxes and gear up		
Valves set		
Tender finished		
Smokebox finished		
Pipes finished		
Cab platforms and frame ftgs.finished		
Tender coupled		
Steam and brake test		
Trial trip		

Type of Locomotive Repair Schedule Used in British Military Shops Near Rouen, France, for Heavy Repairs, Including Renewal of Cylinders and Boiler for Outside Cylinder Type Locomotive

Reasons for Excessive Labor Turnover

Experiences of a Former Railroad Mechanic on Going Back Into That Work in a Western City

BY "NEWT"

It is a well established fact that there are two great wastes in industry today; one the lack of efficiency in management and the other the labor turnover.

After being away from railroad shop work for almost eight years, circumstances recently compelled me to seek work in this field. Being in a certain western city where my acquaintances were few, it was necessary for me to apply for work as machinist in a railroad shop. In view of the wonderful strides made along efficiency lines in many other classes of work, I naturally expected to find many new and better methods, especially for running repair work on locomotives. If the roundhouse I worked in is typical of the methods more generally used, then there has been little change for the better and certainly there is room for great improvement.

THE QUESTION OF PHYSICAL EXAMINATIONS

The first thing that struck me was the objection on the part of the employees to the physical examination, and yet I could see that this is a small but rather important matter as concerns labor turnover. Very few men give good excuses for objecting to it, except that it interferes to a certain extent with their personal liberty. One criticism is that the company requires it and yet compels the men to pay for it. The general opinion advanced by the employees is that if the corporation wants this examination it should pay for it, as it is really no concern of the employee. Another and vital criticism is that after taking the examination, no precautions are taken by the corporation to protect the men in a sanitary way. My own experiences will bear this out, as far as this particular shop is concerned, and to my knowledge many others are just as bad. It is a fact that few men are turned down for shop work on their physical examination.

Is "Newt" Right?

"Newt," in his discussion of the labor turnover problem, scores the railroad in question for miserably inefficient methods and practices.

Is this case an isolated or unusual one? It reads almost like a chapter from the Dark Ages. Certainly the conditions are below the standards which exist on most roads.

Cities have been greatly beautified and improved by the publication of photographs showing examples of filth and untidiness. We shall welcome "pen pictures" from our readers of inefficient and unsanitary conditions which come under their observation on railroads with which they are familiar.

What is the underlying cause of the condition described by "Newt?" In the final analysis who is really responsible for it?

SANITARY CONDITIONS DISGUSTING

After taking a somewhat severe examination I naturally expected that sanitary conditions would be about right in the shop. What was my surprise after the first day's work was completed, to be compelled to wash in a hog trough—a real community trough—which is filled with water and steam heat applied; then as many as 50 men wash in the same water. After three days my face broke out in sores and kept getting worse each day until I finally came to my senses and found a boiler wash lead pipe, where I could wash in cold water with the added pleasure of having my feet get a bath. Should not the doctor in addition to making the physical examination go far enough to see that sanitary conditions are good? Evidently he does nothing of the kind and his work ends just where it really should begin. The general opinion around that "trough" was, "what a farce the physical examination was when such a condition was allowed to exist."

I learned that the matter had been up to the local manager several times and many promises had been made, but the abuse still remained. Is it any wonder men combine to take such matters up with the management? Good men will not stay long in such a place. At a small cost the corporation could install a sanitary washing system which would do away with this cause of dissatisfaction and the resulting improvement in the labor turnover would soon pay for the investment. The engineers and firemen at this particular point were provided with good washing facilities within plain sight of the "hog trough," but the shop men were denied its use. This was rank discrimination and the other workmen did not fail to express themselves concerning it. I am sure a great many objections to the physical examination would be removed if some thought were given to the question of sanitation.

There were 20,000 deaths in this community from influenza; while this wash trough was not the cause of all this trouble, who can deny that it must have been a wonderful agency in helping spread the disease? Who would have gained most if sanitary washing places had been provided for the shopmen?

TOOLS ARE REQUIRED FOR GOOD WORK

Another very strong factor in the labor turnover is the reception a new man usually gets. After reporting for work the first morning I was turned over to an old man, who was supposed to equip me with the necessary tools to work with. It was soon apparent that his only interest was to give out just such tools as he had on hand; he could give no idea as to when the remaining tools, if there were to be any, would be forthcoming. The tools I was furnished with were a monkey wrench, two chisels and a hammer; except for files, this was my entire equipment during the whole time I remained.

No attempt was made on the part of the foreman to acquaint a new man as to how the tools or supplies could be reached. He had no time to attend to such details. As no specialty men were allowed in the shop, mechanics had to do all sorts of work. A man had to hunt a new set of tools for each new kind of work, and he might have a dozen different kinds of work in the day's run. There were two tool rooms or two places where tools were kept; just why I could not understand and the result was that a new man often found himself at the wrong tool room and was compelled to retrace his steps to the other. The result was that a new man was of very little use for the first two or three weeks because of this fact.

One of the tool rooms was presided over by the old man who provided the new man with his tools, as mentioned above; I have seen three and four men stand for 30 minutes waiting for his return from some (very important in his imagination) errand. The only reason I could see for the two tool rooms was to provide this old employee with work. It seems to me he could have been placed where he would have done less harm or else have been pensioned as was suggested by many who had to contend with this vexation.

MATERIAL MIGHTY SCARCE

Another thing that has a very direct bearing on labor turnover, and one that is not given a great deal of thought in many places, is the method of material deliveries to the men who have the real work to do. To make this more clear I will outline some of my experiences. The first thing that was necessary when wanting materials from the storehouse was to go to the office and get an order. This was placed in a box, where it was picked up by the stores department and the materials were then delivered to a box located in the roundhouse. I was given a couple of front end main rod brasses to reduce; before starting the work I ordered a half-round file with which to do the work, thinking it would surely be delivered by the time it should be needed. When ready for the file, I went to the delivery box and it was not there, this being about one and one-half hours after starting the work. After going to two or three machinists in an endeavor to borrow one, I finally managed to find an old worn out file and to get the work done in time to prevent any delay in the movement of the engine to the train. The new half round file was delivered 24 hours later. Good fortune played into my hands in this respect, for I happened to be going by the delivery box at the time the file was delivered; otherwise it would have found its way into some other man's equipment. Why was the stores department so long in making this delivery, or if it was short on this item why was there no advice as to non-delivery, in view of the fact that the order had been O.K.'d by the proper party?

Some may say this was an isolated case, but to show what a farce this delivery actually was I will recite some other experiences. A few hours later it was necessary for me to order some small bolts for a drop pit engine and being in no hurry I thought I would see how long it would take to get the material. After placing the order in the usual manner I waited until the next morning before going to delivery box. Not finding the bolts I had another order placed and again waited. After going to the box the third morning I went to the clerk and explained the circumstances and after phoning the stores department the third order was placed and then came the delivery. Before I had time to reach the box more than half the bolts had been taken. You can readily see how much time was wasted on such a small matter. Upon asking some of the older men what they did when they wanted materials in a hurry I was told there were some scrap cars about 1000 feet from the house and that they usually went there and after searching managed to find something for a makeshift.

My contention is that the materials should be delivered promptly or the mechanical department notified at once so that provision may be made for some method of getting the material without a high priced mechanic spending his time hunting in the scrap pile. There seemed to be no co-operation between the mechanical and stores department as far as efficient delivery of materials was concerned.

INADEQUATE SUPERVISION

Another feature that has a very direct bearing on the labor turnover is the manner in which the work was supervised. The organization at this particular place consisted of one assistant master mechanic, general roundhouse foreman, roundhouse foreman and assistant roundhouse foreman. The assistant roundhouse foreman, as far as I could see, did most of the work, his duties consisting of taking all the work off the engineers' reports, distributing this work, as well as all the inside and outside inspectors gave him, handling the engines on the drop pit, and handling the machine shop where the roundhouse work was mostly done; this shop was one hundred feet from the house and on the opposite side from the office. He also kept 48 machinists busy. The general roundhouse foreman made a trip or two a day through the house and the roundhouse foreman spent most of his time at the turntable; indeed I have often seen him taking a turn at running the table.

Much has been written about keeping the number of men handled by any one man down to 30, but here was a man handling at least 75 men in addition to all the other duties mentioned. If that man had been burdened with less duties he could have given more time to seeing that the men were properly supplied with tools and have given more direct supervision to their work.

KEEPING DOWN THE LABOR TURNOVER

I would suggest some of the following things to help keep down the labor turnover:

Matters Causing Dissatisfaction.—Intelligent consideration should be given to the complaints from individuals rather than to let them reach a stage where some labor organization can make them a grievance. After the medical examination is given see that proper sanitary measures are taken to safeguard the employees, especially in providing suitable places for washing and for the men to hang their clothes. It was three weeks after I went to work before I was provided with a place to hang my clothes. When I spoke to the general foreman about it I was informed that there would be more cupboards next day, but they had not arrived when I left the service. This is a matter entirely up to the local manager and proper thought and consideration on his part would easily have removed this cause for dissatisfaction.

Lack of Proper and Sufficient Tools.—Every man should be equipped with a full complement of small tools to keep the trips to the tool room down to the minimum. Proper checking of the tools a man has when he begins and leaves the service would go a long ways in keeping down the loss of them and more than pay for the money invested. Many railroads think that giving a man small tools that should be carried (in their estimation) in the tool room is a distinct loss, but after being around a shipyard and seeing the methods used there in this respect, I am sure much time would be saved, and money too, if all mechanics were properly equipped with small tools. In the shipyards it takes about one and one-half hours to get a clearance and most of this time is spent in "squaring up" with the tool room. If the railroad shop spent half this time checking a man in and out what a saving it would be.

Proper Supervision.—This question is rather a hard one to solve, but its relation to the labor turnover is very intimate. The man who is kept reasonably busy by a foreman who knows how to get the work out of his men is a much better contented and a more reasonable man. Indifferent care in this respect forces good men to move. Wages have reached such a high level that a reasonable amount of attention to the above details will go a long way in stopping the turnover, which is a big factor in helping to make railroad shop costs soar skyward.

Car Shortage Likely in Fall.—A statement has been authorized by the Southern regional director's office to the effect that only the most careful handling of cars by the railroads with consistent and wholehearted co-operation from the shipping public can prevent another shortage of freight cars during the coming fall and winter. It is stated that every piece of equipment is now in use on many lines.

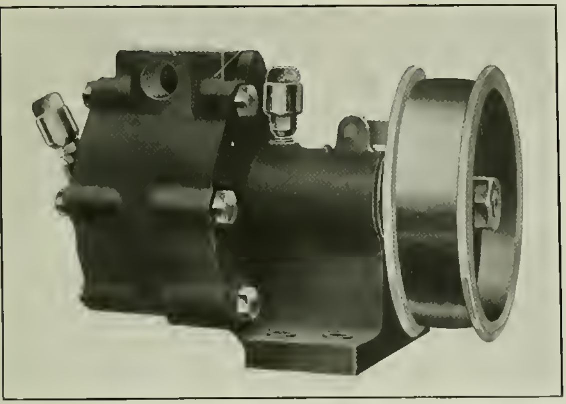
NEW DEVICES

THE ROLLWAY PUMP

A new departure in pump design has been developed and placed on the market by the Michigan Machine Company, Detroit, Mich. This pump, known as the Rollway, is especially designed for pumping cutting tool lubricants.

The end sought in designing this pump was the elimination of such trouble as loss of prime, clogging, inadequate suction and short life. These pumps have now been in use for more than a year and have been found to possess these qualities and are said to have shown many other advantages as well.

The illustrations show the simplicity of the pump construction. The principal working parts consist of two rollers which rotate eccentrically in the pump chamber. The entire motion is rolling, thus eliminating all wear which is caused by the scraping of working parts against the pump chamber.



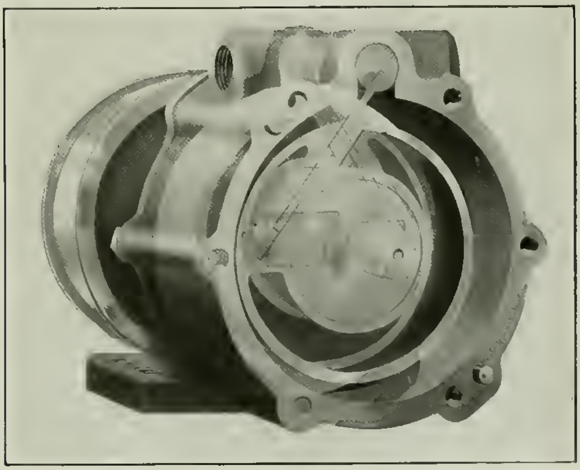
The Rollway Self Priming Pump

The pump is self-priming, may be used anywhere within 10 ft. above the level of the liquid and will prime itself, requiring no valves. This positive suction is not affected by aeration, as is the case with many other pumps. The tank from which the liquid is being pumped may be entirely emptied and the pump allowed to suck air, and when the tank is refilled it will immediately prime and start pumping again. No relief valves or overflow piping are required. The outlet in the discharge piping may be closed and the pump allowed to run without damage to itself or the piping. This result is obtained by the use of a spring placed in the rectangular slot in the inner roller, which bears against the squared shaft. This spring operates only when the pressure on the pump is as great as the pressure required to compress the spring. When this pressure is reached the compression of the spring allows the rollers to come to the center of the pump, where they continue to revolve in the liquid without exerting further pressure on it.

The pump is not affected by foreign matter in the liquid, and will not clog. Any particles, such as cast iron and steel chips, paper, rags, waste, etc., which can pass through the intake pipe will pass through the pump without clogging or damaging it in any way. The action of the pump is to roll the liquid in front of the pump rotor, so that should anything stick, the spring will compress, allowing the roller to pass over the obstacle without damage. The foreign matter will be washed out on the next revolution of the motor.

The pump is universal and may be used with either side up and at any point on a machine where its application is most convenient. Either side of the pump may be used as intake or outlet. Plain pumps may be used on a reversing machine where no liquid is required when the machine is reversing. The pump can be reversed without harming it, and it will deliver liquid again immediately its proper direction of rotation is resumed. A pump equipped with reverse valves is furnished where it is necessary to maintain a constant flow in a given direction regardless of the direction of the rotation of the pulley.

Speed is not a factor in the efficient operation of the Rollway pump. It may be operated at speeds ranging from 100 to 600 r. p. m. or more, making it applicable to all types of machines without the extra expense of making special provision for either high or low speeds in order to secure maximum efficiency. The fact that it may be operated at very low speeds insures long life where low speed can be obtained.



Interior of the Rollway Pump

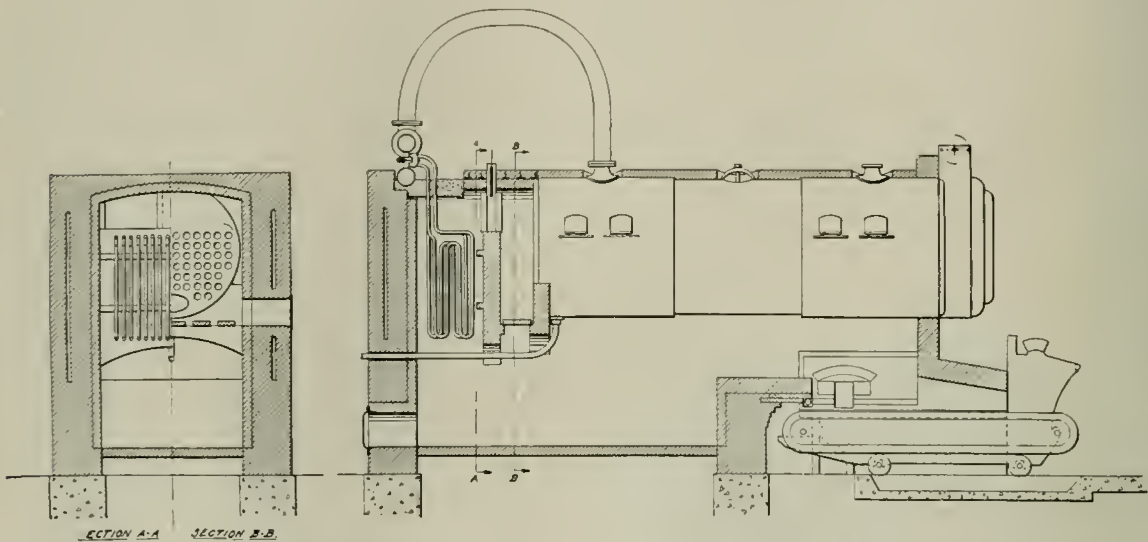
The Rollway eliminates the necessity of using numerous sizes and types of pumps in order to obtain maximum efficiency on various types of machines and the necessity of carrying repair parts for different types of pumps. It operates with equal efficiency in pumping either water or oil, and the low horsepower required per gallon of liquid pumped permits a considerable economy in cost of operation.

These pumps are furnished with controlling springs to develop 25 lb. pressure at 200 r. p. m., or for higher or lower pressures as may be required.

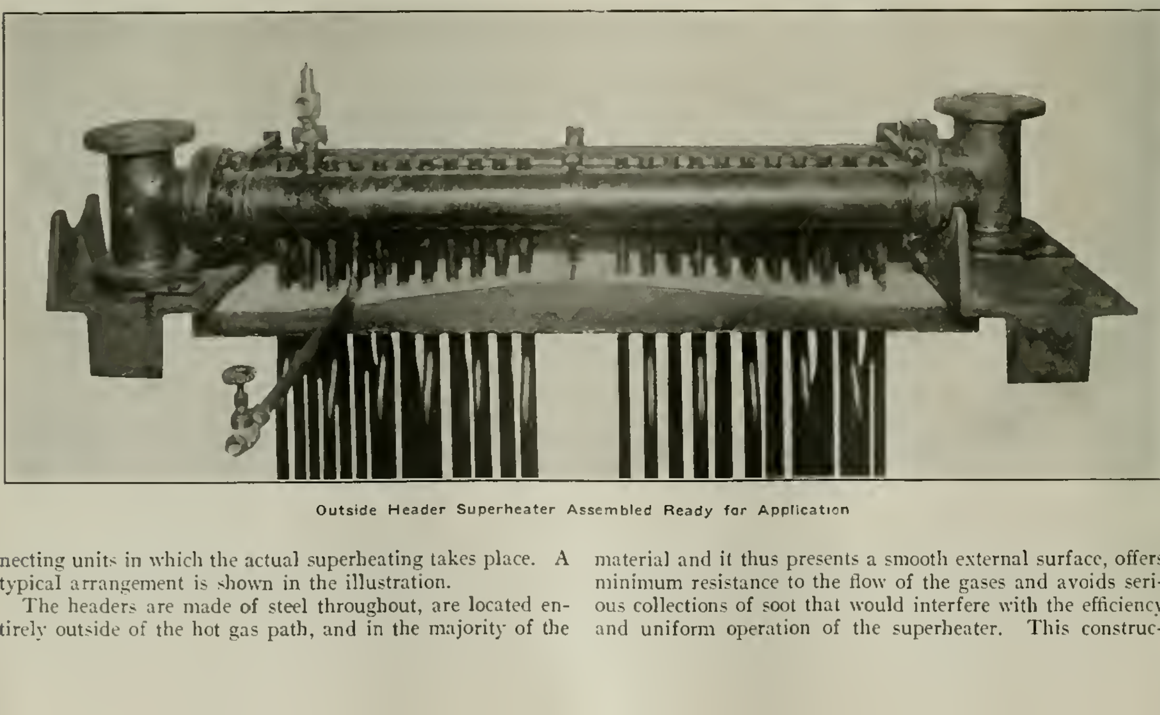
SUPERHEATER FOR STATIONARY BOILERS

An adaptation of the locomotive type of superheater to stationary boilers is being introduced by the Locomotive Superheater Company, New York. This superheater is known as the Elesco.

The superheater consists of two headers, one acting as the distributor for the saturated steam coming from the boiler and the other a superheated header for the collection of the steam after it has been superheated, and the necessary connecting units in which the actual superheating takes place. A typical arrangement is shown in the illustration.



Elesco Superheater Adapted to a Horizontal Return Tubular Type Boiler



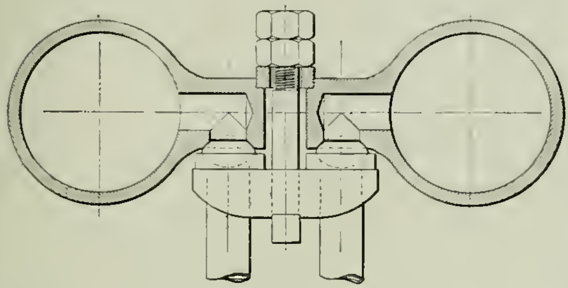
Outside Header Superheater Assembled Ready for Application

The headers are made of steel throughout, are located entirely outside of the hot gas path, and in the majority of the designs, outside of the boiler setting proper, so that the headers as well as the unit joints are accessible for inspection and repairs without entering the boiler setting. The advantage of such an arrangement will readily be appreciated. Safety valves conforming to the A. S. M. E. Boiler Code are provided and are located near the outlet. Provision is also made for drainage and connections for thermometer cups.

In most cases the headers are made with the outlet on the superheated header in an opposite location to the inlet on the saturated header, assuring an even distribution of the steam flow through all units. Where conditions are such as to require it, the saturated header is provided with several inlets.

The superheater units are made of heavy, cold drawn seamless steel tubing of the proper diameter to give correct steam areas. The tubing is not covered with any other material and it thus presents a smooth external surface, offers minimum resistance to the flow of the gases and avoids serious collections of soot that would interfere with the efficiency and uniform operation of the superheater. This construction also brings the steam into intimate contact with the gas-touched heating surface, and gives a low resistance to the flow of heat from the gases to the steam.

The form of the unit is such as to permit free expansion and contraction of all parts. The tubes are bent on specially designed machines that do not weaken them or reduce the steam areas. Ample provision is made to prevent the pipes from warping. In cases where severe moisture and scale conditions are prevalent, the units can be made so that they may be satisfactorily cleaned on the inside. Due to the fact that the units are made of small diameter tubing, it is possible to obtain correct relations between steam areas and heating surface and so distribute the cross sectional area through the superheat as to obtain the most desirable steam velocity without the use of cores. The use of cores in super-



Ball Joint Connection Between Units and Header

heater tubes causes a considerable drop in pressure through the superheater, because of the added frictional resistance of the steam and where bad water and foaming occurs, the small space between the cores and the inside of the tubes is quickly stopped by scale-forming material.

The connection between the units and headers is a metal to metal joint. This joint is made so as to permit the easy removal of the units without special tools, and its use also avoids two holes in the header which would be necessary with rolled joints. Any unit in the superheater can be disconnected without interference with the other units, and the work of disconnecting a unit, which consists merely of loosening a bolt, can readily be done by the ordinary power plant attendant.

The ball end, as shown in the illustration, is formed integral with the tube by a special forging process. The ball is then faced and ground, and fits into a ground seat in the header, which is made at an angle of 45 degrees. The clamps and washers are made of forged steel, and the header bolts are made of heat-treated alloy steel, with an elastic limit of not less than 75,000 lbs., per square inch. This joint, while a new departure in stationary superheater design, has been used in a great number of locomotive superheater units and has withstood the extremely hard service of locomotive operation.

This superheater is suitable for application to all types of vertical or horizontal fire tube or water tube boilers and the possible fuel economy and increase in boiler efficiency make its use very desirable.

AN OPEN TYPE LOCOMOTIVE FEED-WATER HEATER

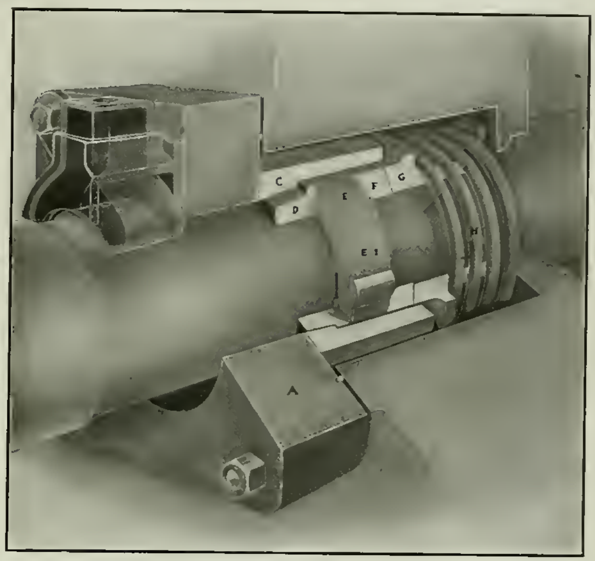
A typographical error in the description of the Worthington feedwater heater, which appeared on page 495 of the August issue, erroneously gave the capacity of the heater as 6,000 lb. of water per hour. This should have read 60,000 lb. of feedwater per hour.

Q & C PISTON ROD PACKING AND LUBRICATOR

The Q & C Packing & Lubricator Company, New York, is marketing a piston rod packing and lubricator.

THE Q & C PACKING

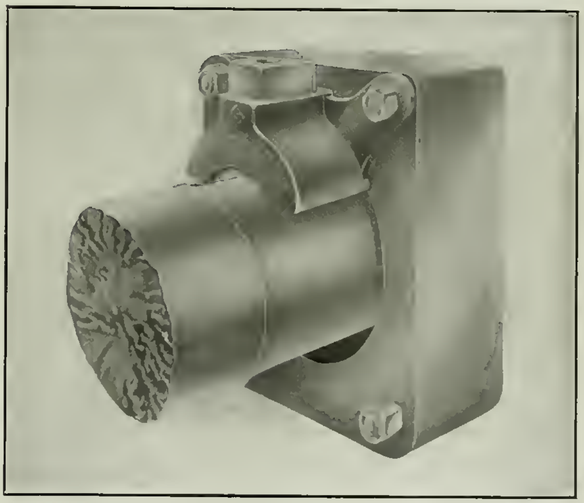
The packing is so designed that it is held tight against the rod by steam pressure, and the spring shown at the back serves only to hold the parts in place. By this means the wear



Piston Rod with the Packing and Lubricator Applied

of parts is practically limited to the time in which steam is actually used, thus greatly prolonging the life of the packing.

The cylinder head is bored out to sufficient depth and diameter to receive the packing. All of the parts of the



Application of the Piston Rod Lubricator

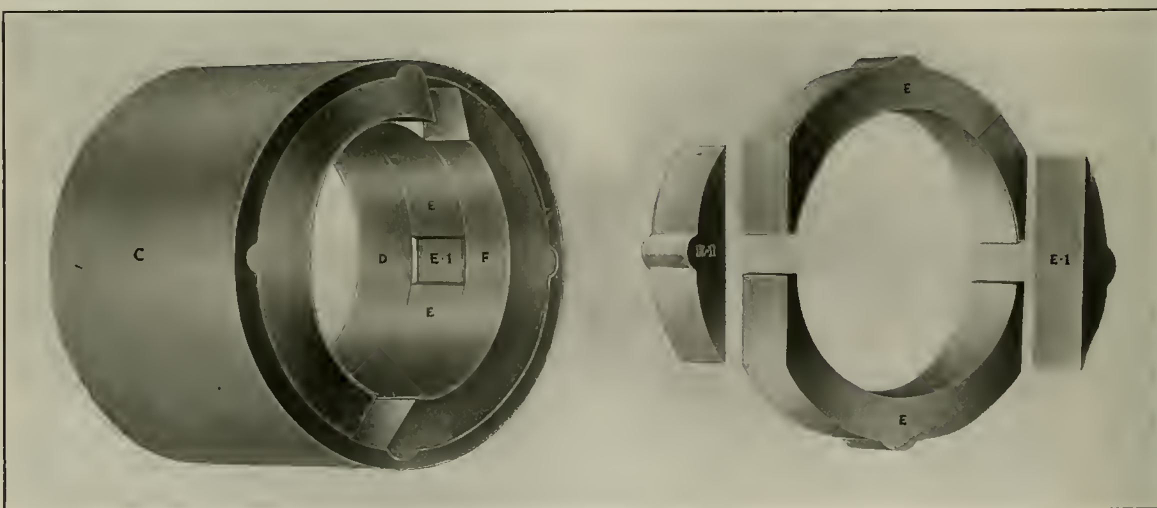
packing are made in two pieces with the exception of the retaining sleeve *C*. This is made in one piece and, in order to put it in place, the piston rod must be taken out of the crosshead. It is turned to slip easily into the cylinder head and bored out to take the retaining sleeve bushing *D*, the packing ring *E*, the packing shoe *E*-1 and the packing ring *F*.

These three sets of rings are made in sections. The parts *D* and *F* are made in two pieces each, and when the parts are brought together they can be entered in the sleeve and fit loosely on the rod. The parts *E* and *E*-1 are in two pieces each, so that four pieces are used to form the complete ring. The joints of the three sets of rings are made to break so that there is no longitudinal leakage of the steam.

The spring stop *G* has a bevel face bearing against *F* so that the latter is prevented from lifting the rod. The spring *H* has a tension only sufficient to hold the parts in place and prevent longitudinal movement under the action of the piston rod. The outward thrust of the spring passes through the rings to *D*, which is held by its lip bearing against the shoulder turned on the inner face of *C*, and *C* has a bearing against the gland *A*.

Steam enters the packing chamber from the cylinder and circulates freely over the rings, bushing and sleeve. The steam has the same access to the space between these parts and the piston rod, but as the outer surfaces of the rings are greater than the inner, the excess of pressure on those surfaces forces the parts against the rods and makes a tight joint. The instant the steam throttle is closed the pressure is relieved and the engine drifts without any pressure being exerted on the rod, so that the packing is purely steam actuated without the spring having any influence on the actual tightening of the parts.

Leakage of steam past the gland is prevented by a copper wire that is inserted between the gland and the cylinder head.



Details of the Piston Rod Packing Rings

THE Q & C LUBRICATOR

The lubricator shown in the illustration was designed to overcome the difficulties experienced with the ordinary cotton swab. This device consists of a brass shoe or cup held loosely within a retainer and free to adjust itself to the diameter and position of the piston rod, without appreciable wear on the rod. The hollow shoe is filled with lubricant and attached to the cylinder head as shown in the illustration. The use of this lubricator eliminates such trouble as glazing of the lubricating material or strands of the swabbing being drawn into the packing rings, thus causing steam leaks. The easy self-adjustment of the shoe insures long service and low cost of piston rod lubrication.

REGO WELDING AND CUTTING TORCHES

The Bastian-Blessing Company, Chicago, has developed torches for welding and cutting in which an original departure from existing apparatus has been made in the principle of mixing the gases. In these devices, which are known as the Rego torches, the acetylene is delivered at the mixing chamber under a pressure slightly greater than the pressure of the oxygen. With this arrangement the acetylene holds back any excess of oxygen under all conditions, thus eliminating the flashback which is a source of continual annoyance in most welding and cutting torches.

In the construction of the torch several innovations are introduced; no high pressures are used, the acetylene pressure even on tips larger than ⅛ in. being only 9 lb. In order to secure the correct volume of the gases, the mixing is accomplished in the tip so that the mixing chamber is changed each time that a different tip is applied. This form of construction facilitates repairs and reduces the volume of the mixed gases. The tip is of an alloy high in copper and is made without a thread and with a cone seat having a broad angle to prevent the tip sticking in the head.

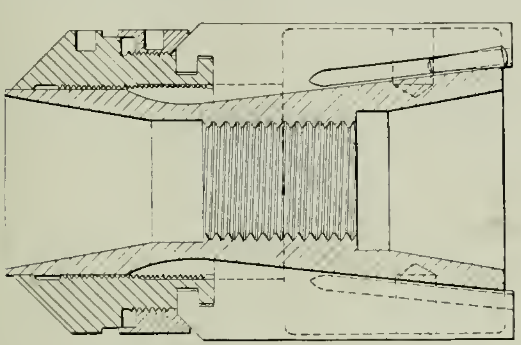
The cross section of the oxygen passage leading to the mixing chamber is of substantially the same cross section as the mixing chamber itself, while the acetylene passages have a cross section equal to approximately one-half the area of the mixing chamber. Both gases are delivered to the point where they mingle at a velocity higher than the rate of flame propagation in the mixture which will produce the neutral flame. The arrangement of the passages normally produces the neutral flame, and any obstruction of the tip will result in excess of combustible gas in the mixing chamber which reduces the rate of flame propagation at the point of mixing. Thus, if a condition is present which tends to cause a flashback the acetylene immediately shuts off the oxygen, automatically thus producing a rich mixture which will not backfire.

It is claimed that this torch positively prevents the flashback, thus eliminating the time wasted in relighting the torch. It is also claimed that it effects a marked saving in the gas consumption, insures a better quality weld and permits of employing less skilled labor than can be used with torches which do not employ the same principles of mixing the gases.

DAVIS EXPANSION REAMER

The old style of solid shell reamers have been in use for a long time, but with the constant improvement of other machine shop equipment, the necessity for a reamer whose blades could be expanded, to compensate for wear, has been keenly felt. To meet this situation the Davis Boring Tool Company, St. Louis, Mo., has developed the Davis expansion reamer. It is claimed that the design possesses all the advantages and eliminates all the disadvantages of the solid reamer.

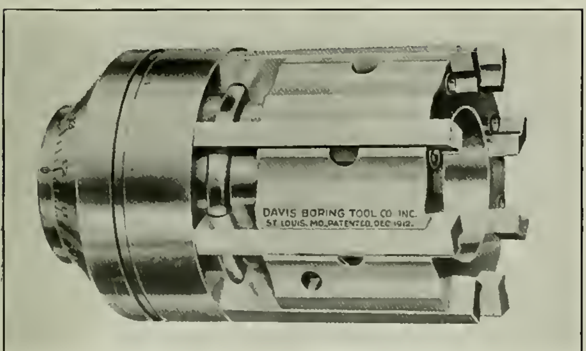
The distinguishing features of the Davis expansion reamer are simplicity and practical construction, with the minimum number of parts. The blades are positively controlled by an



Cross Section of Davis Expansion Reamer

accurate micrometer adjusting dial, graduated in quarter thousandths, which acts for both expanding and receding of blades. The blades are slotted and fit over the ring on the adjustable dial which prevents their movement either way, without turning the dial. When the reamer is set to the size required the blades are individually and doubly locked to the reamer body by a locking principle which positively locks the blades without the use of screws, virtually making a solid reamer.

The elimination of screws for holding the blades in a



Expansion Reamer Which Indicates Several New Features

reamer body is a distinct advantage. The blades are held with a special taper hardened and ground pin, which is fitted to the reamer body and to a groove in the blade resulting in a constant downward and lateral thrust that firmly holds the blades under all conditions. They are then clamped to the reamer body with the locking ring threaded on the adjusting dial, making it impossible to expand or recede the blades either by accident or carelessness without releasing the locking ring, which must be done before the expanding dial can be turned in either direction.

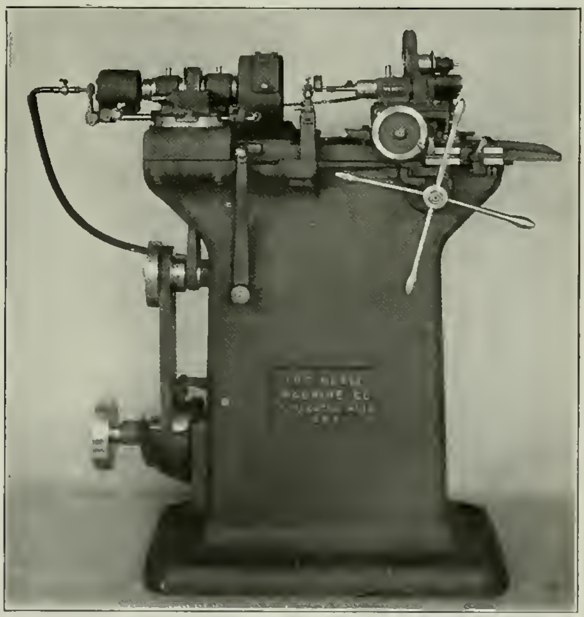
This reamer represents the first application of the forward movement of blades, for the purpose of expansion in a tool of this type. This feature always keeps the blades cutting in advance of the tool body, consequently the blades never lose their bottoming feature. The movement of the blades is positively controlled by the adjusting dial, which expands or recedes them. The blades have liberal expansion, with one-quarter thousandth adjustment and the locking of the blades is absolute and positive. Among the distinctive features of Davis expansion reamers is simplicity of driving which eliminates the necessity of making costly arbors. Any size can readily be applied without interfering with the driving shank. True alinement is assured when assembled in multiple form, virtually making a solid line reaming bar.

Blade efficiency and the cost of blades is an important factor which should be considered in connection with adjustable reamers. Davis expansion reamers require but three groups of blades to cover a range of sizes from 1⅝ in. to 6 in. inclusive. When the blades for a 6-in. reamer are worn under size they can be used in a number of smaller sizes down to and including 4 1/16 in. Blades for a 4-in. reamer can be used in smaller sizes down to 2½ in. Blades in a 2 7/16-in. reamer can be used in smaller sizes down to 1⅝ in. This wide range of adjustment permits of reaming the maximum number of holes per set of blades.

These tools are made either in the shell type or with a solid shank, straight or taper, to which a floating holder can be applied. All wearing parts are hardened and all threaded parts are protected from dust, chips or possible injury, which might result from careless usage or accident.

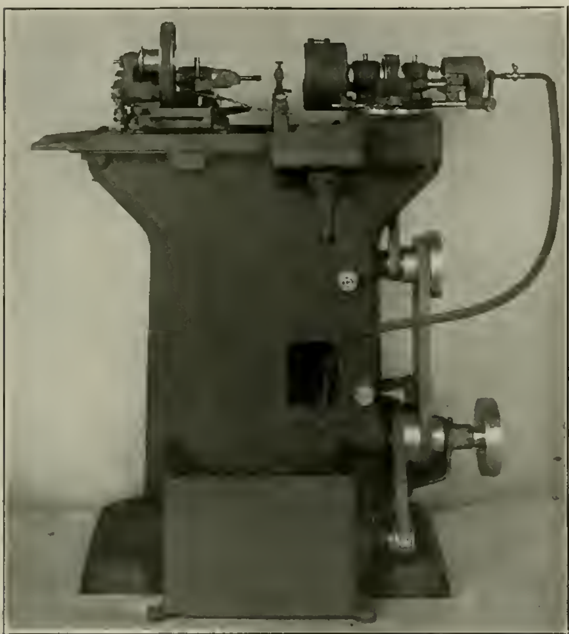
HEALD NO. 85 INTERNAL GRINDING MACHINE

An internal grinding machine designed especially for small, short work is being made by the Heald Machine Company, Worcester, Mass. This machine is of simple design and is very strongly built. A conveniently located pilot



Front View of the Heald No. 85 Grinder

wheel furnishes hand feed movement to the table and a quick acting collet operated by a lever with an automatic brake to the working head, which also shuts off the water, reduces the chucking time to a minimum. The wheel heads are of an entirely new design and have proved very successful. The working head is driven by a cross belt through the base from a four-step cone, giving three speeds of 161, 292 and 528 r. p. m. It is arranged to swivel and is graduated to permit 4-in. taper to the foot. The rotation of the working head is automatically stopped and the water shut off when the grinding wheel is withdrawn from the work. This is accomplished by means of a friction clutch in the base, operated by a lever on the front of the machine. As the table moves to the right a small dog attached to it engages the lever and throws the clutch out. To resume work the operator simply pushes the lever back into its vertical position, starting the working head and the water. The working head is bolted directly to the base of the machine and is fitted with adjustable dustproof bronze bearings. The working spindle is made of high grade steel, ground and lapped, the front bearing being 1⅝ in. in diameter and the rear bearing 1⅜ in. in diameter.



Rear View of the Grinding Machine

The holding fixture furnished with this machine consists of a quick-acting collet chuck with a capacity of ⅜ in. diameter up to 3 in. This is operated by a lever with an adjustable compensating device, which prevents distortion of the work. The feed to the cross slide is calibrated to one-quarter thousandths of an inch. The feed lever is at the left side of the cross slide, enabling the operator to keep his right hand on the pilot wheel while using his left hand to feed the slide. The main table has flat and "V" ways, and is extremely rugged for a machine of this size. It is provided with a positive stop accurately governing the travel, thus enabling the operator to grind up to a shoulder or any given point without danger of overrunning.

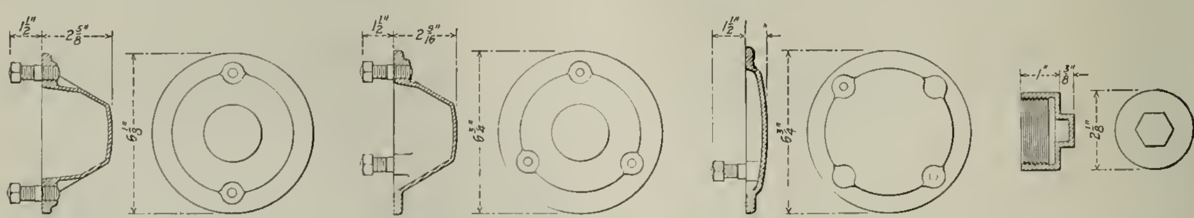
To reduce vibration to a minimum an overhead countershaft has been used. This shaft is of simple construction, having two steel hangers equipped with self-alining ball bearings, a driving pulley, a drum for the flexible idler and tight and loose pulleys to receive power from the main line, and it has a speed of 600 to 620 r. p. m. A wheel guard automatically covers the wheel as it is withdrawn from the work. This prevents injury to the operator's hand while plugging the work. The idler pulley is fitted with ball bearings and keeps an even tension on the spindle and countershaft belts at all times.

The water equipment includes a pump, tank, water guard and connections. The water tank and pump fit into the back of the base of the machine, requiring only a few more inches of floor space than the machine itself. This machine was designed for work ranging from ¼ in. to 2 in. in diameter by 4 in. long, and is especially adapted for use on holes smaller than ¾ in. in diameter by 1½ in. long. The actual swing inside the water guard is 6 in., while without the guard it is 10 in.

The machine is equipped with a wheel head having solid, adjustable taper bearings at the wheel end, with ball bearings at the pulley end. Another style of head is designed so that different sized quills may be inserted in the nose of the spindle. These quills are tapered which, when put in with a slight tap on the end of the quill, gives it a firm grip and practically makes it a part of the spindle. These heads are complete units in themselves, each having its own pulley, thereby securing correct spindle speeds.

SHIPPING CAPS FOR WESTINGHOUSE TYPE OF TRIPLE VALVES

Among the devices recently developed by the Westinghouse Air Brake Company, Wilmerding, Pa., are shipping caps for various types of triple valves. The illustrations show these caps which are designed to protect the cylinder flange end and the threaded check case connection of the valves during shipment. The caps were devised to meet an urgent demand for a protective device to be used in shipping triple valves from point to point on the railways and when returning them for repairs. Three caps constitute a set which takes care of all existing standard triple valves manufactured by the Westinghouse Air Brake Company. In the case of the type *H* and type *P* triple valve, two caps are required, one for the brake pipe connection in the check valve case after the union nut and swivel have been removed.



Caps for Protecting Triple Valves During Shipment

The caps are made of cast iron and are substantially proportioned to retain their shape and permit of being used an indefinite number of times. Studs as shown in the illustration are made an integral part of the casting, thus insuring that they will always accompany the caps. The bell portion is of proper size to provide clearance for the retarding device and the chucking threads on the *K* type triple valves.

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 11,400 copies were printed; that 10,174 of these 11,400 copies were mailed to regular paid subscribers, 20 were provided for counter and news company sales, 211 were mailed to advertisers, 28 were mailed to employees and correspondents, and 967 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 84,610, an average of 9,401 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

A company has been formed, says the Times (London) Trade Supplement, for the manufacture of special rolling stock for India which contains no wood.

Memberships in French labor unions have increased five-fold since the beginning of the war. At that time the French Labor Confederation had about 300,000 members. At the present time their membership has increased to about 1,500,000.

The Traveling Engineers' Association has announced that the question of the amalgamation of this association with Section III, Mechanical, of the American Railroad Association has been considered by a committee. Its findings will be presented at the convention which opens on September 16, at which time it is expected that the association will take definite action on the matter.

A pamphlet entitled Treatment of Industrial Problems by Constructive Methods is being sent to employers by the office of the director general, U. S. Department of Labor, with a chart showing the various subdivisions of the Department of Labor and the details handled by them. The working conditions service of the department is intended to offer a constructive plan for reducing industrial accidents and sickness and to render assistance in making better working conditions.

The contention that it is not always the inexperienced apprentice or helper who, through ignorance, adopts unsafe practices in his work, is made by George Bradshaw, supervisor of safety on roads under the jurisdiction of Federal Manager Frank H. Alfred in Educational Letter No. 18. Two instances are cited in support of this contention, one a case where a machinist who was reaming out holes with a hardened steel reamer struck the hardened end of the reamer with a hammer to make it go into the hole before putting the wrench on it. A piece of steel flew off and struck him in the eye, but fortunately the injury was slight. The second case was that of the workman who was about to cut off a file in a shear when one of his fellow workers stopped him.

A controversy among machinists arose on the St. Louis-San Francisco because of the appointment of W. J. Foley as general roundhouse foreman at North Springfield, Mo., and strike ballots were sent out. The contract between the company and the machinists states that a machinist shall be placed over machine men, and it is this clause of the contract that the men claimed had been violated in the appointment of Mr. Foley, who was formerly a locomotive engineer. He was later promoted to road foreman of engines and then was acting assistant superintendent in the operating department until the return of the assistant superintendent from government service. In defense of the appointment of Mr. Foley, officers of the road say that no portion of the contract between the machinists and the company has been violated, because the duties of the general foreman cover not only machinists but boilermakers, pipefitters, electricians, tank men and miscellaneous repairmen as well as engineers and firemen. Mr. Foley has been a member of the Brotherhood of Locomotive Engineers.

Steam vs. Electrical Working of Locomotives

An abstract by the Technical Supplement of the Review of the Foreign Press from an article in the Zeitschrift des Oesterreichischen Ingenieure und Architekten-Vereines, states that the railways of German-Austria only use about one-tenth of the entire coal consumption of the country. Details of the coal consumption are given, pointing out that with the modern superheaters the locomotive has become much more efficient than formerly. Steam locomotives are stated to work more efficiently than electric locomotives especially where goods trains are concerned; and even in Switzerland the cost per ton-kilometer on the electric railways is often higher than on the railways worked by steam. The whole argument is to the effect that only under certain conditions will electrical working prove cheaper than steam working.

Classification of Technical Employees in the Northwestern Region

A definite step toward the classification of technical employees of the engineering, mechanical, land and valuation departments was recently made in the Northwestern region through the issuance of a communication by R. H. Aishton, regional director, to the federal managers of railways in the Northwestern region for their information and guidance. This schedule is of particular interest because of the detail in which the duties, responsibilities, degree of technical training and extent of experience are treated in defining each classification. The statement covers positions in the engineering, mechanical, land and valuation departments below the grades of assistant engineer and chief draftsman, and the definition of each grade includes a salary rating giving the maximum and minimum limits of salary comparable to the character of services rendered in each grade.

Authority is given to apply this classification as effective July 1, 1919. No overtime is to be allowed men covered in this classification.

The schedule for the five classes of particular interest to the mechanical department is as follows:

DRAFTSMEN, CLASS 1, $200-225

On general or special duty, requiring special knowledge, training and experience, and a special degree of initiative and originality, thoroughly competent, engaged regularly in the design and general direction of the design of large and difficult work on yards and terminals, track details, etc., or steel, concrete and timber bridges and structures, or special buildings, etc., or locomotives, cars, special machinery, mechanial and electrical power plants, etc.

DRAFTSMEN, CLASS 2, $175-190

On general or special duty, requiring special knowledge or training and experience and the use of initiative and originality. Engaged in the general designing and the direction of detailing of plans of yards and terminals, track details, etc., or steel, concrete, or timber bridges and structures, or special buildings, power plants, etc., or locomotives, cars, special machinery, or signals and signal apparatus, or land, right-of-way and valuation maps and profiles from field notes and records.

DRAFTSMEN, CLASS 3, $150-165

On general or subordinate duty, requiring special knowledge or training, experience and initiative, generally engaged in the designing and detailing of work in accordance with standard practices, and the direction of work of a minor character on right-of-way maps, mileage records, or steel, concrete and timber bridges and structures, or locomotives, cars, special machinery, mechanical and electrical power plants, or signals and signal apparatus, or land, right-of-way and valuation maps and profiles from field notes and reords.

DRAFTSMEN, CLASS 4, $125-140

On subordinate duty requiring a certain amount of knowledge, training or experience, and engaged generally in detailing, compiling and recording general engineering plans, land and right-of-way maps, or valuation maps and profiles, or records of bridges, buildings, locomotives, cars or signals.

TRACERS, $100-120

On subordinate duty requiring a certain amount of experience or knowledge of drafting. Capable of doing neat, accurate and rapid work.

MEETINGS AND CONVENTIONS

Chief Interchange Car Inspectors' and Car Foremen's Association.—The nineteenth annual convention of this organization will be held on September 23, 24 and 25, 1919, at the Planters Hotel, St. Louis, Mo.

The Traveling Engineers' Convention.—The Railway Equipment Manufacturers' Association announces that 65 firms have already arranged for space at the exhibit which will be held in connection with the convention of the Traveling Engineers' Association at the Hotel Sherman, Chicago, on September 16, 17, 18 and 19.

Foundrymen's Association Convention.—The annual convention of the American Foundrymen's Association will be held at the Commercial Museum, Philadelphia, September 29 to October 3. In connection with this convention there will be one of the most extensive exhibits of machine tools and shop devices ever displayed. Over 200 companies will be represented, among them a large number whose products are widely used in railroad shops.

Steel Treaters Society.—The first convention of the American Steel Treaters Society will be held in the Seventh Regiment Armory, Chicago, September 23 to 27, inclusive. The sessions will be held in the morning, afternoon and evening. An extensive exhibit is planned in connection with the meeting. Among the subjects covered by the papers will be the selection of steel, the design of tools, the heat treatment of steel for various purposes, case hardening, and equipment for heat treating. The papers are intended to cover the latest practice in every branch of the art of heat treating and are prepared by recognized experts. Non-members as well as members of the society may attend the meetings and join in the discussions.

The following list gives names of secretaries, dates of next or regular meeting, and places of meeting of mechanical associations:

AIR-BRAKE ASSOCIATION.—F. M. Neilis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD ASSOCIATION, SECTION III—MECHANICAL.—V. R. HAWTHORNE, 431 South Dearborn St., Chicago.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawler Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, secretary, Federal Reserve Bank Bldg., St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION — H. J. Smith, D. L. & W., Scranton, Pa. Convention September 23-25, Planters Hotel, St. Louis, Mo.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention September 2-5, 1919. Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA. —A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Convention, September 16-19, Hotel Sherman, Chicago.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	....	....	....	James Powell	P. O. Box 7, St. Lambert, Que.
Central	....	....	....	H. D. Vought	95 Liberty St., New York.
Cincinnati	Sept. 9	Locomotive Construction	W. A. Austin	H. Boutet	101 Carew Building, Cincinnati, O.
New England	Oct. 14	....	....	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Sept. 19	Purchasing and Stores Organizations	H. B. Spencer	H. D. Vought	95 Liberty St., New York.
Pittsburgh	Sept. 25	Economic Disposal of Waste Material	C. H. Clark	J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	Sept. 12	The Railroad Question of Today	Dr. Wm. G. Raymond	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Sept. 15	Electric Car Lighting	E. Wanamaker	J. M. Byrne	547 West Jackson Blvd., Chicago.

PERSONAL MENTION

GENERAL

Lieut. Leigh Budwell has resumed his duties as mechanical engineer of the Richmond, Fredericksburg & Potomac and the Washington Southern, with headquarters at Richmond, Va., having just returned from 12 months' service in the Transportation Corps in France, where he served as master mechanic in the 16th Grand Division. B. J. Coffman, who has been acting mechanical engineer during the absence of Lieutenant Budwell, has been assigned to other duties in the mechanical department.

S. D. Dimond has been appointed chief electrician on the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at St. Paul, Minn., succeeding J. R. Smith, who has been appointed signal supervisor.

B. F. Kuhn, master mechanic on the New York Central lines west of Buffalo, with office at Ashtabula, Ohio, has been appointed assistant superintendent of motive power, with headquarters at Cleveland, Ohio.

Herman F. Noyes, whose appointment as superintendent of fuel economy of the Maine Central and the Portland Terminal with office at Portland, Me., was announced in the July issue of the *Railway Mechanical Engineer*, was born on August 1, 1877, at Freeport, Me., and was graduated from the University of Maine in 1899. He began railroad work on March 4, 1902, as a fireman on the Maine Central, being promoted in August, 1906, to the position of assistant air brake inspector and in February, 1907, air brake inspector. He was appointed motive power inspector on August 4, 1913, his title being changed in June, 1918, to traveling engineer, and served in that capacity until his appointment recently as superintendent of fuel economy.

H. F. Noyes

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

F. M. Crandall, assistant master mechanic on the New York Central lines west of Buffalo, at Collinwood, Ohio, has been appointed master mechanic, with headquarters at Ashtabula, Ohio, and has jurisdiction over the Franklin division, including the Oil City branch, the Franklin & Clearfield branch, Ashtabula and Youngstown yards, and the Alliance division.

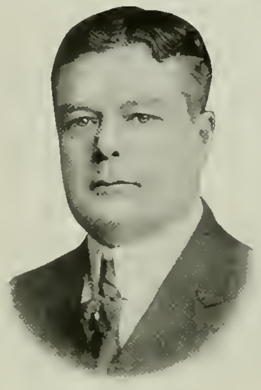
PURCHASING AND STOREKEEPING

J. D. East has been appointed division storekeeper of the Baltimore & Ohio Eastern Lines, with headquarters at Keyser, W. Va., succeeding C. S. Filler, resigned.

G. H. Greer, storekeeper on the Yazoo & Mississippi Valley, with headquarters at Vicksburg, Miss., has been appointed storekeeper for the Gulf, Mobile & Northern, at Mobile, Ala., succeeding R. C. Brown, resigned.

SHOP AND ENGINEHOUSE

H. H. Maxfield, whose appointment as acting works manager of the Pennsylvania Railroad, Eastern Lines, with office at Altoona, Pa., was announced in the June issue of the Railway Mechanical Engineer, has been appointed works manager. He has charge of the Altoona shops, comprising the Altoona machine shops, the Altoona car shops, the Juniata shops and the South Altoona foundries, and reports to the general superintendent of the Eastern Pennsylvania division. Mr. Maxfield was born in 1873 and was educated at Stevens Institute. He entered the service of the Pennsylvania Railroad on September 5, 1885, as an apprentice in the Meadow shops. On August 1, 1899, he became machinist and in March, 1900, inspector and gang leader. He was promoted in December, 1902, to assistant master mechanic at the Pavonia shops of the Trenton division and in April, 1903, was appointed assistant engineer of motive power of the New Jersey division at Jersey City. On April 1, 1905, he was appointed master mechanic of the Trenton division and in July, 1911, was transferred to the Pittsburgh division in the same capacity. On May 1, 1916, he was promoted to superintendent of motive power of the Western Pennsylvania division and about June, 1917, was transferred to the New Jersey division, with office at New York. In July, 1917, he was granted a furlough to enter military service as an officer in the Ninth Engineers, and while in France he was superintendent of motive power of the Transportation Corps, American Expeditionary Force.



H. H. Maxfield

OBITUARY

George J. Duffey, superintendent of motive power of the Lake Erie & Western, with headquarters at Lima, Ohio, died at his home in that city on August 16. He was born at Clinton, Ont., Canada, on May 24, 1863, and began railway work as an apprentice on the Michigan Central at St. Thomas, Ont., and served later as roundhouse foreman and general foreman on that road. In 1907 he left the service of the Michigan Central to go to the Chicago, Indiana & Southern as general foreman at Gibson, Ind. On June 1, 1908, he was appointed superintendent of shops of the Lake Erie & Western at Lima, Ohio; on November 1, 1908, was promoted to assistant master mechanic and in March, 1911, was again promoted to master mechanic. Since January 1, 1916, he served as superintendent of motive power on the same road.

Harry H. Hilberry, master mechanic of the Eastern division of the Pennsylvania Lines West of Pittsburgh, with headquarters at Pittsburgh, Pa., died in that city on August 5, aged 50 years.

W. H. Watkins, master mechanic on the Illinois Central at Memphis, Tenn., who was granted a leave of absence in the early part of this year, died at his home in Memphis on August 22. at the age of 50.

SUPPLY TRADE NOTES

George J. Lynch has been appointed sales manager for the Youngstown Steel Car Company, with headquarters at Youngstown, Ohio.

The Page Steel & Wire Company, New York, has opened a branch office at 29 South LaSalle street, Chicago, and another in the Book building, Detroit.

The Falls Rivet Company, Kent, Ohio, is preparing plans for the construction of a new building at Kent. It is probable that work on the new structure will not begin before early spring.

The Schroeder Headlight & Generator Company, Evansville, Ind., has appointed S. Herbert Lanyon as its representative on the Pacific coast, with office at 507 New Call building, San Francisco, Cal.

The Chicago Railway Equipment Company, Chicago, is completing plans for the reconstruction of that part of its plant which was damaged by fire on August 2. About $25,000 will be expended on the work.

J. L. Canby has been appointed district manager of sales of the Chicago Pneumatic Tool Company, Chicago, with offices at Chicago, succeeding Nelson B. Gatch, who has been transferred to the New York office.

A. E. Braun, president of the Farmers Deposit National Bank, Pittsburgh, Pa., has been elected a director of the Pressed Steel Car Company, New York, to fill the vacancy caused by the death of T. H. Given.

Earle W. Vinnedge has received his discharge from the military service and has been appointed sales engineer for the Worthington Pump & Machinery Corporation, New York, with headquarters at Cincinnati, Ohio.

T. L. Dodd & Co., Railway Exchange building, Chicago, have been appointed western sales representatives of the Worth Steel Company, Claymont, Del., manufacturers of fire box steel plates, boiler and tank plates.

L. H. Elliott has been elected vice-president and secretary of the Upson Nut Company, Cleveland, Ohio, succeeding Norris J. Clarke, who has resigned. Mr. Elliott will retain his former position as secretary and treasurer of the Bourne-Fuller Company, Cleveland.

The Anglo-Saxon Trading Corporation, 114-A Pitt street, Sydney, Australia, advises through its New York office that it desires to receive catalogues and full particulars from manufacturers of all kinds of devices relating to the mechanical side of railway transportation.

James M. Monroe has resigned as representative of the Southeastern territory of the Hunt-Spiller Manufacturing Corporation, Boston, Mass., to become vice-president of the Harry Vissering Company, Chicago, and vice-president of the Charles R. Long, Jr., Company, Louisville, Ky.

Herbert Duckworth has been appointed sales manager of the grinding wheel division of the Norton Company, Worcester, Mass.; Howard W. Dunbar has been appointed sales manager of the grinding machine division; John C. Spence, superintendent, and Charles H. Norton chief engineer.

W. Terry Field, constructing engineer for the American Car & Foundry Company, New York, with office at Detroit, Mich., has resigned to form a partnership with John R. Fordyce, formerly Major and Construction Quartermaster at Camp Pike, Ark. The new firm will be known as Fordyce & Field, consulting and construction engineers, Little Rock, Ark.

The Railway Motor Car Company of America, Chicago, plan to construct a manufacturing plant at Hammond, Ind., at an approximate cost of $80,000. The building will be 300 ft. long by 100 ft. wide, 50 ft. of which will be two stories high. The superstructure will be of brick construction.

E. T. Sawyer has been appointed a representative of the railway sales department of the U. S. Light & Heat Corporation, Niagara Falls, N. Y. Mr. Sawyer will specialize on car lighting equipment and electric car welders and will have his headquarters at 30 East Forty-second street, New York City.

The Rickert-Shafer Company, Erie, Pa., is making plans for the erection of another wing to the factory building, 33 ft. by 150 ft., two stories high, of steel and brick construction, in order to take care of the increased demand for Boehm automatic die heads and R & S tapping machines. The company is also about to place several new tools on the market.

F. O. Slutz has been appointed manager of the railway sales department of the B. F. Goodrich Rubber Company, Akron, Ohio, succeeding C. M. Woodruff, who has resigned to accept a position with the Akron Board of Education. Mr. Slutz was born on April 29, 1883, and received a high school education. He entered the service of the B. F. Goodrich Rubber Company, on October 24, 1901. In 1909, he served as a clerk in the pneumatic tire sales department and the following year was transferred to the railway sales department, where he served in various positions, giving most of his attention in recent years to railway sales work exclusively, until his appointment as manager of the same department. Mr. Slutz will have his headquarters at Akron, Ohio.

F. O. Slutz

Captain Thomas O'Leary, Jr., of the Fifty-First Engineers, has returned to the service of the New York Air Brake Company, New York, as western representative on lines west of the Missouri river. Captain O'Leary was adjutant of the Touraine division of the Fourteenth Grand division, Camp De Grasse, France, operating the French railroad out of that place.

The Ryan Car Company, Chicago, is constructing an all-steel, steel car plant 90 ft. by 600 ft., upon a recently acquired 50-acre tract one-half mile east of its old plant at Hegewisch, Ill. In addition to the main plant three smaller buildings are being constructed. It is expected that operation will begin in the fall. The approximate cost of the new buildings with new equipment will be $350,000.

F. B. Hartman has been appointed representative of the Hunt-Spiller Manufacturing Corporation, Boston, Mass. He is to cover the southeastern district, succeeding J. M. Monroe, who has resigned to become vice-president of the Charles

H. Long Company. Previous to 1906 Mr. Hartman was in the service of the Union Pacific and later was with the Southern Railway, part of the time as general equipment inspector.

The Onondaga Steel Company, Inc., Syracuse, N. Y., is making plans for building several new additions to the plant at James street and Thompson road, Syracuse, in 1920. To carry out this program the capitalization of the company has been increased from $150,000, to $1,000,000. The new building program calls for an annealing plant 160 ft. by 40 ft., an 80-ft. extension to the present mill building and several other buildings.

American Car & Foundry Company

The directors of the American Car & Foundry Company, New York, having recently abolished the office of general manager, James M. Buick, formerly vice-president and general manager, has assumed the direction of the sales division of the company and will be known as vice-president in charge of sales.

W. C. Dickerman

The production division will be directed by William C. Dickerman, who will be known as vice-president in charge of operations. He will be assisted by Frederick A. Stevenson, as assistant vice-president in charge of operations, who will be head of the manufacturing section and have charge of production in the car plants, rolling mills and foundries, also supervision over the engineering improvement and research, patent and industrial relations sections. The headquarters of both divisions will be at the general offices, 165 Broadway, New York. Mr. Dickerman, as head of the war division, and Mr. Stevenson, as his assistant, directed the company's recent program in the manufacture of munitions for the government of the United States and its allies.

F. S. Stevenson

William C. Dickerman was born on December 12, 1874, at Bethlehem, Pa. After a preparatory course at William Penn Charter School, Philadelphia, he was graduated from Lehigh University in 1896, with the degree of mechanical engineer. Mr. Dickerman entered the employ of the Milton Car Works, Milton, Pa., in 1897, and when the American Car & Foundry Company was organized he was made assistant district manager for the Milton district. In 1900 he became sales agent of the company and in 1905 was elected to the vice-presidency.

Frederick A. Stevenson was born on April 6, 1880, at Detroit, Mich. After completing the high school course, he entered the employ of the American Car & Foundry Company in 1899, as an apprentice in the machine shop at the Detroit plant. In 1902 he was transferred to the Berwick plant and served as master mechanic in charge of all mechanical work in the steel car department, and in 1907 he returned to Detroit to assume a similar position in the company's plant. In 1909 he entered the assistant general manager's department at Chicago and carried on the development of new ideas and methods until October, 1910, when he became assistant general superintendent of the Detroit plant. In 1912 Mr. Stevenson was made general superintendent at Detroit and held this position until January, 1916, when he was appointed assistant general manager.

J. Leonard Replogle, president of the American Vanadium Company, New York, also president of the Wharton & Northern Railroad and chairman of the board of directors of the Wharton Steel Company, who, during the period of the war was director of steel supplies for the War Industries Board, has had conferred upon him by the French government the decoration of Chevalier of the Legion of Honor, in recognition of services rendered by him in the Allied cause during the war.

The Schroeder Headlight & Generator Co., Evansville, Indiana, announce the opening of two new offices. One of these offices, in charge of Harlow A. Varney, district sales manager for the company, is located at 1051 McCormick building, Chicago. The second office, at 507 New Call building, San Francisco, will be the headquarters of S. Herbert Lanyon, district sales manager for the Pacific coast territory. Both Mr. Varney and Mr. Lanyon have had a number of years experience in the railway supply business.

Roland S. Lebarre, assistant manager of sales for the Cleveland, Ohio, district of the Carnegie Steel Company, Pittsburgh, Pa., has resigned to become general sales manager of the alloy steel department of the Interstate Iron & Steel Company, Chicago. He began his business career 20 years ago with the United States Steel Corporation and in 1902 entered the sales department of the Illinois Steel Company. During the past 14 years he has been assistant district manager of sales for the Carnegie Steel Company, at Cleveland.

The Duff Manufacturing Company, Pittsburgh, Pa., is constructing an addition of 160 ft. by 80 ft., to its works at Pittsburgh. The new building is of brick and steel and is designed to accommodate the forge shop and heat treating department. Provision has been made for installing 16 steam hammers, with an equal number of trimming presses. The heat treating department will be equipped with furnaces of the latest type, burning either oil or gas. The completion of the new forge shop, about October 1, will make possible a large increase in the production of Duff jacks.

At the annual meeting of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., on August 13, the following directors were elected: R. C. Caples, E. H. Gold, J. E. Kepperley, C. L. Lane, C. O. Miniger, J. O. Moore, B. J. O'Reilly, J. A. Roberts, G. G. Shepard, J. Allan Smith and J. N. Willys; and the following officers were elected for the ensuing year: John N. Willys, chairman of the board of directors; E. H. Gold, vice-chairman of the board of directors; J. Allan Smith, president; C. L. Lane, vice-president and general manager; R. C. Caples, vice-president; B. J. O'Reilly, treasurer; R. H. Van Nest, secretary, and T. G. Swannie, assistant secretary and assistant treasurer.

The Chicago Pneumatic Tool Company, Chicago, is now erecting a 10-story office building at 6-8 East Forty-fourth street, New York, in which will be housed its general offices now at Chicago. The new building will be completed early in 1920. The structure will be of steel, brick and limestone construction and will be occupied solely by the offices of the company. The ground floor will contain a permanent exhibition room and display of its pneumatic and electric drills and other tools, gas engines, air compressors, etc. A completely equipped service station will also be maintained. The six American plants and 26 sales and service branches will be directed from New York. A sales and service organization will be maintained in Chicago on a more extensive scale than formerly.

George H. Richie, sales engineer in New England and Eastern Canada for the Sullivan Machinery Company, Chicago, has been promoted to New England sales manager, succeeding George Elmer Wolcott, deceased. R. S. Weiner has been appointed district manager with headquarters at El Paso, Tex., in place of Don M. Sutor, who has been transferred to the St. Louis, Mo., office as sales manager for Missouri, Arkansas, eastern Texas, Oklahoma, Kansas (except the oil territory), western Kentucky and western Tennessee. Phillips S. Jarvis has resigned as sales manager for the territory controlled from the St. Louis office and Marion C. Mitchell has been appointed sales manager for the territory in Indiana and Illinois previously controlled from the St. Louis office, with temporary headquarters at St. Louis. Daniel H. Hunter has been appointed sales manager for Louisiana, Texas (except the southwestern section), and the oil fields of Oklahoma and Kansas with headquarters at Dallas, Tex.

The housing facilities of the Westinghouse Air Brake Company, Wilmerding, Pa., are to be extended at once by the erection of a number of new dwellings, for the families of employees. The Westinghouse Air Brake Home Building Company has been organized with a capital of $1,000,000 to transact all business relative to the real estate and dwellings, which have been transferred by deed to this company by the Westinghouse Air Brake Company. It includes over 400 houses and considerable vacant property in the borough of Wilmerding and adjacent territory. The officers of the new organization are A. L. Humphrey, chairman of the board of directors; C. A. Rowan, president; W. S. Bartholomew, vice-president, and H. C. Tener, secretary. In addition to the first three mentioned above J. F. Miller and G. W. Wildin are included in the board of directors. S. R. Gittens has been appointed manager. Since the Westinghouse Air Brake Company built its first houses for employees in 1890 there has never been an increase in rents and the new company will carry out the same policy.

The Detroit Seamless Steel Tubes Company has begun construction of a $3,000,000 plant on a 60-acre tract at Detroit, Mich. The first unit of the plant will cost $1,000,000 and will be completed by January 1, 1920. The building plans call for a structure of steel and glass with brick and concrete facing. The plant proper will occupy a space of 350 ft. by 700 ft. It will consist of three bays for manufacturing units, a separate heating plant and a two-story administration building. The three manufacturing units will be each 90 ft. wide, by 700 ft. and 550 ft. long and 45 ft. high, to permit the use of traveling cranes and other labor saving machinery. The interior layout and special tube mill machinery was designed under the direction of C. A. Ross, consulting mechanical engineer, and C. L. Stafford, mill superintendent. The plant will be equipped with the latest types of modern labor saving devices and machines, and a powdered coal system will be used for all the heating and annealing processes used in manufacturing operations. The total capacity of the first unit of the new plant will be 2,500 tons of seamless steel tubing a month, the range of sizes being from one-half inch to six inches outside diameter, and No. 13 gage and heavier.

CATALOGUES

Window Fixtures.—Catalogue W-19 of the O. M. Edwards Company, Inc., Syracuse, N. Y., contains 64 pages and should prove of practical value to car designers. It contains considerable detailed information about the fixtures and the service for which the various designs are best adapted and by means of drawings clearly shows their application to single and double sash windows. All of the detail parts, such as sash balances and brackets, sash locks, racks and lifts, compression devices and weather stripping, are shown in numerous sketches and photographs.

Welding Rods and Wire.—A small booklet of 60 pages has been published by the Page Steel & Wire Company, New York, which contains a large amount of useful information on welding and welding materials and describes the method of manufacturing Armco iron rods and wire for oxy-acetylene and electric welding, illustrated with microphotographs showing the structure of the material used. The booklet contains a large number of other illustrations and data in tabular form, including a table showing the diameter of rods to be used on various thicknesses of metals to be welded, temperature and metric conversion tables and data regarding the properties of elements and metal compositions, etc.

Texaco Lubricants.—The series of advertisements of the Texas Company, New York, entitled "How Texas Jones Convinced the Railways," which has appeared in the *Railway Mechanical Engineer*, has been reprinted in a booklet of 39 pages, 9 in. by 12 in., issued by the Texas Company. Thirty pages each contain a record in dialogue form, with illustrations, of imaginary meetings of a railroad purchasing board, showing the evidence brought by "Texas Jones" and others to convince the railways of the value of using Texaco lubricants. In addition the book contains a list covering four pages of railroad products made by the Texas Company.

Steel Tanks and Boilers.—A cloth bound book of 96 pages, 6 in. by 9¼ in., has been published by the Coatesville Boiler Works of Coatesville, Pa., manufacturers of steel tanks for a large variety of uses, A. S. M. E. boilers, stacks, open hearth furnaces, blast furnaces, cement kilns, regenerators, etc., to show the vast scope of the business and the great variety of heavy steel plate work manufactured in the shops of this company. This is indicated in over 100 illustrations. Included in the book are the specifications for steam boilers formulated by a committee appointed by the American Society of Mechanical Engineers, in accordance with which Coatesville boilers are made. The book is designated as General Catalogue No. 24.

Steam Pumps.—Several bulletins have been issued by the A. S. Cameron Steam Pump Works, New York, describing their pumps, which are bound together in a heavy manila folder. Included among these are Bulletin 7204, which explains the general characteristics and operation of Cameron steam piston and plunger pumps; bulletin 7152, showing the construction of a single suction volute centrifugal pump, with tables of capacities, speeds and horsepowers; bulletin No. 7251, covering two-stage motor driven and three-stage turbine driven centrifugal pumps and giving complete information regarding their operation, specifications and detail parts; and bulletin 7150, describing and illustrating the general design of a double suction volute centrifugal pump, including the results of tests made with this pump and useful information regarding the friction and pressure of water.

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CONTENTS

An Educational Campaign Necessary

Railroads generally have made the same mistake as other industries in not giving critical attention to the Americanization of aliens in their employ. A study made by employment experts indicates that a large percentage of the misunderstandings with labor in industrial organizations is due to the fact that foreigners do not appreciate the conditions under which they are working and the ideals which dominate American industrial establishments. A comparatively small amount of educational work along these lines in some establishments has been very helpful in promoting harmony and in eliminating possible sources of trouble. The seriousness of the alien problem is no more clearly indicated than by the steel strike. The American born workers are apparently against the strike and are loyal to their employers, while the foreign born, or aliens, are supporting the strike and are apparently entirely in the hands of the radical element. It is time that every railroad and every department on the railroad took careful steps to study its labor conditions and wherever necessary to introduce intensive educational work tending to completely Americanize all of its employees. Work along this line will certainly result in a more effective organization.

Limitations of Welding

The oxy-acetylene and electric welding processes have been found suitable for such a wide variety of work that some have gained the impression that autogenous welding can be used satisfactorily under practically any conditions. One large railroad recently had two wrecks due to the failure of welded parts, which illustrates the disastrous results that may follow if welding is not confined to its proper sphere. These wrecks occurred in an interval of a few weeks and in both cases the cause was traced to a welded car axle. Appearances indicated that at some time brake rods or other parts had borne on the axle and had worn a groove around it. This depression had been filled by welding and the axle had been reapplied. Instead of strengthening the axle, the heat of the welding operation probably affected the structure of the metal, weakening it and resulting in failure under load. The damage caused by these two wrecks amounted to several thousand dollars and it is hardly necessary to point out that this would have been sufficeint to pay for a considerable number of new axles.

The American Railroad Association Committee on Welding Truck Side Frames, Bolsters and Arch Bars has recommended that welding cracks or fractures should not be permitted on axles, arch bars, car wheels or tires, truck equalizers, spring or bolster hangers, brake wheels, coupler bodies or knuckles, knuckle pins, locks, lifters or throwers, or on parts made of alloy steel or heat treated carbon steel. Although the welding of these parts has not been officially prohibited by the association, the committee's report will almost certainly be adopted. At any rate, it would seem that roads that have made a practice of welding the parts named above might do well to follow the recommendations of the committee.

Injustice to Stores Department

The stores departments of the railroads have faced a most difficult situation during the past year or so. The men in this department have not been organized and for some reason the Railroad Administration has left the readjustment of wages and salaries to the regional authorities. The matter was finally attended to in some regions, but the employees in other regions have up to this time had little, if any, consideration. Not only have the storekeepers themselves been discouraged because of lack of recognition in the revision of salaries, but they have bad to struggle along as best they could with the payment of very low wages to their employees, as compared to the other departments alongside of which they have been working. This was quite forcefully brought out in the discussion of the paper which was presented at the September meeting of the New York Railroad Club by Director of Purchases Henry B. Spencer. Complaint was also made of the large amount of red tape which the storekeeping departments are having to observe in connection with the preparation of reports preliminary to the turning back of the railroads to their owners.

In the words of one of the speakers, the stores department could make good under the present conditions if it was required to provide only those things which were essential and could cut out the frills. In reply to this criticism, Frank McManamy, assistant director of operation, claimed that the ball of red tape was small as compared to that used on some of the railroads under former conditions. George G. Yeomans, the assistant director of purchases, stated that the requirements of the Railroad Administration were burdensome only to those roads which did not keep accurate records as to the amount of material on hand and where it was located. Regardless of these statements, however, the testimony of storekeepers generally is that the conditions under which they are now working are extremely difficult and burdensome and that some relief should be afforded, both in making suitable allowances for the wages and salaries of men in this department, as well as the elimination of all reports that are not absolutely essential.

Is the Five Coupled Engine a Success?

The progressive increase in the size of road engines has in recent years led to the adoption of the Santa Fe and Decapod types to replace the Consolidation and Mikado. Railroad officers have considered it axiomatic that as the tractive effort of locomotives increases the cost of wages for train and engine men and of locomotive repairs would decrease (on a ton-mile basis). So long as this holds good the adoption of heavy motive power would prove economical as the other two large items of expense, locomotive fuel and maintenance of way and structures, were only slightly affected by the size of the locomotives. Some statistics of the cost of maintenance of locomotives with five pairs of drivers which have recently been compiled indicate that there is some room for doubt as to whether the introduction of these locomotives has reduced the cost of transportation.

The cost of maintaining the machinery on Santa Fe and Decapod locomotives has been found to be disproportionately high. The wear on side rod bushings, back end main rod brasses and driving boxes is excessive. Tire wear in some cases amounts to as much as 1-16 in. per month, necessitating turning the tires every 20,000 miles. In some designs the boiler tubes have been placed too close together in the attempt to secure adequate heating surface, and this has made frequent tube renewals necessary. Where the roadbed has many curves, locomotives with five pairs of drivers have proved extremely hard on the track.

Against these disadvantages must be weighed the advantage of the heavier train load to be secured due to higher tractive effort. In this connection it is well to note that each successive increase of 10,000 lb. in the tractive effort causes a smaller reduction in the cost of wages for the train crew per gross ton mile. Furthermore, the cost of locomotive repairs and enginehouse expenses on a ton-mile basis is greater than the cost of wages for enginemen and trainmen, therefore a decrease in the cost of wages may be more than offset by an increase in the cost of locomotive maintenance.

The Santa Fe and Decapod types have probably not been in service long enough to determine definitely under what conditions they can be operated more economically than the Mikado type. The data given above indicates that careful consideration is necessary to avoid costly mistakes in the selection of heavy motive power.

Bad Order Car Situation

With the approach of the winter season and its attending difficulties of transportation the freight car situation is a matter of concern not only to railroad men but to the people of the entire country. The condition of freight cars in general is of great moment, but the most vital question is whether or not we are to have efficient service in the distribution of fuel. In recent statements made before the Senate committee investigating the coal situation we find a wide divergence of opinion as to the probability of a coal shortage and the necessity of immediate attention being given to the repair of bad order cars, of which there are undoubtedly a great number—far too many. The coal producers insist that they are not supplied with coal cars in sufficient numbers to warrant the constant operation of the mines; that at many of the mines it has been necessary to suspend operations entirely for extended periods (285 mines were reported idle during the week of July 26) because of the car shortage.

The Railroad Administration, however, contends that there is no serious car shortage and that car repairs are being made as rapidly as conditions require. Recent statements by Railroad Administration officials indicate that for the purpose of keeping down expenditures the car repair program has been much curtailed in recent months and that this accounts in part for the increase in the number of bad order cars. The Railroad Administration claims to have the situation under control and that any coal shortage will not be due to lack of cars.

Whatever may be the merits of either side of this controversy it is a fact that the general condition of freight cars throughout the country is bad. Evidence of this may be seen at any terminal. The aspect of the bad order car situation is not very bright in view of the conditions existing during the last half of 1918 and the fact that the working hours of the shopmen have been very considerably reduced during 1919 the result of which can not have been other than to reduce the output of repairs.

The reports of the railroads to the Division of Operation of the Railroad Administration covering a period of 10 weeks from July 20 to September 21, 1918, show that while the number of cars requiring heavy repairs increased from 49 per cent to 59 per cent of the total number listed as in bad order, only about 10 per cent of the cars reported as turned out of shop during that time were given heavy repairs. This indicates that many cars requiring heavy repairs were given only sufficient attention to put them in such condition as would permit their use—in other words, they had been turned in for heavy repairs and were given only light repairs. This practice of putting off the evil day can not be too strongly condemned, as it inevitably leads to a generally poor condition of equipment and merely adds to the difficulty of eventually putting the cars in proper condition.

The steady increase in the percentage of cars requiring heavy repairs and the reduced output of the repair shops makes it highly improbable that the car repair situation is under control or in a very encouraging condition at the present time. For the purpose of keeping down expenditures the needed repairs have been neglected during the present year and it is quite probable that since the opportunity to remedy the poor condition during a favorable season has passed, we can look for no great improvement now that the demands for cars will become greater, unless immediate and adequate steps are taken to remedy the bad order car situation.

It is the plain duty of those entrusted with the production and distribution of a necessity such as coal to leave nothing undone that might cause disruption of the service to which the consumer, who, of course, must pay the bills, is entitled. While the doctors disagree on the diagnosis the patient frequently dies of the disease. Have done with quibbling over the cause and apply the remedy.

Wage Systems and Shop Efficiency

At the present time there is a great deal of discussion concerning the relative cost of doing work on an hourly wage basis of payment and under special wage systems, such as piecework or bonus plans. Some contend that the abolition of piecework has reduced the shop output very greatly; others claim that operations can be performed quite as economically under the day work system if the supervisory force is properly organized. Whatever the ultimate effect may be, there is no question that some shops that have changed from piecework to day work are finding the readjustment to meet the new conditions very difficult.

Special wage systems have been likened to patent medicines that often proved remedies for many of the diseases of the shop system. They supplied an individual incentive for high production which counteracted the effects of inadequate supervision, lack of facilities and poor shop arrangement. The piecework system caused the men to plan their work to avoid delays as much as possible while the fixing of rates for various operations necessitated close attention to the details of the work, which disclosed wastes and led to their correction. In order to secure as good results from day work as were secured when piecework was in operation, some other agency must be supplied to effect the performance of these functions.

One of the handicaps which have often been overcome by piecework is a poor shop layout. When each man is interested in having work brought to his machine promptly the foreman is not called on to give much attention to the delivery of material, regardless of the defects in the arrangement of tools in the shop. Under a daywork system there is more need for a scientific layout and for co-operation with the workmen to eliminate wasted time. With the incentive for following up work removed, adequate crane or trucking service and means for furnishing the necessary tools and drawings without delay are essential.

Of even greater importance than the routing and distribution of work is the detailed study of shop operations and the establishment of definite standards to gage results. This could be followed out as well under day work as with piecework, but there is some question as to the feasibility of establishing such systems under present conditions. The labor organizations which are now the recognized representatives of the shop craftsmen have in the past opposed any detailed time studies of machine operations in any of the union shops.

The unions have maintained that time studies were only a means of exploiting the workers, while the railroad officers have interpreted the opposition as an attempt to decrease production and to shield inefficient workmen. Time studies, if rationally employed, would be of great benefit in improving shop operation and there is no inherent reason for opposition on the part of labor organizations. There seems to be developing among the officers of the American Federation of Labor a tendency to recognize the fact that high production is the only guarantee of prosperity for the workers. The position which this organization has assumed in the past may be considerably modified and the objections to detailed studies of shop operations may be abandoned. The matter has such an important bearing on shop costs that the future attitude of the federation will be watched with a great deal of interest.

Some Neglected Recommendations

During the past two months conventions were held by several of the mechanical associations which had not met since 1916. Among the most important action taken at these conventions was the renewal of recommendations made in previous years but not yet adopted by the railroads.

The Master Blacksmiths' Association brought out the benefits that could be derived by a standardization of certain details of safety appliances. At the present time brake staffs are made with drums of various diameters and lengths. The Safety Appliance Act forbids the welding of brake staffs, therefore, in case a broken brake staff cannot be duplicated from stock it must be forged by hand, which is an expensive process. A standard brake staff could readily be designed which would vary only as to length and a limited number of lengths could be adopted to meet the requirements of all ordinary types and sizes of freight cars now in service.

A like situation exists with regard to grab irons. The safety appliance standards mention four different lengths, namely 14 in., 16 in., 18 in. and 24 in. The roads, however, have not adhered to these dimensions and as the welding of grab irons is not permitted under the M. C. B. rules, it is often a difficult matter to replace one that is broken. If standard designs of each of the lengths given above were adopted, one type for application to the car body and another for use with wooden or metal stiles, these eight different sizes could be made to meet practically all of the requirements.

Definite action intended to bring about a standardization of small tools was taken at the convention of the Tool Foremen's Association. Many of the hand tools which are now made in railroad shops could be purchased at a saving if the manufacturers were able to meet the demands of all the railroads with a single design. Due to minor differences in the sizes of squares, or lengths and diameter of shanks, these tools are now classed as special material. Not only is the price considerably higher than for standard types but the time required to fill an order is also much longer. The makers of small tools would willingly co-operate with the railroads in establishing standards and it is to be hoped that the work begun in 1915 will now be carried to a successful conclusion.

Another matter which has awakened renewed interest is the purchase of paint and varnish on specifications, which was brought up at the convention of the Master Car and Locomotive Painters' Association. The immediate cause of the protest against specifications for these materials was the inferior quality of the paint furnished under the Administration's requirements. The shortage of linseed oil makes it almost necessary to accept substitutes, but this will not necessarily result in lowering the quality of the material as many of these substitute oils have been thoroughly tested and found superior to linseed oil for certain purposes. Apparently, the specifications have led to the use of inferior grades of linseed oil and have sustained the contention of the master painters, that practical tests, backed by the guarantee of a reputable manufacturer form the best basis for buying paint and varnish.

COMMUNICATIONS

INADEQUATE MAIN DRIVING BOXES

Philadelphia, Pa.

To the Editor:

Your article in a recent issue in regard to the main driving boxes for large locomotives calls to mind some experience with driving boxes that were hard to get running nicely, and what I thought then and still do should be a satisfactory solution of the difficulty. The ordinary form of driving box has a bearing on only one side of the shaft, and while this has worked well in the past with small locomotives, there does not always seem to be bearing in the proper place, and it is not the best form for lubrication.

My attention was first called to this matter a few years ago, when in the mechanical department of an Eastern road. This road had some three-cylinder locomotives in high-speed passenger service which were built about 10 years ago. They were fine machines, ran fast and well, and were in general very reliable. But they had one defect—they were very hard to break in service—and even after they were running well it was always possible that they would suddenly develop hot boxes. Designed originally for grease lubrication, the first one refused to run until oil, with a force feed lubricator, had been substituted. This gave results, but after any shopping at which work was done on the driving journals or brasses there was always the same difficulty. The development of hot boxes seemed to be a matter of the attention paid to the lubrication; sometimes a locomotive working out of our roundhouse would go a surprisingly long time without any trouble, out of another it would develop a hot box in a very short time. After any general overhauling the work of breaking in the locomotive would be about as follows. The locomotive would be run leisurely up the line and back again, and on its return be looked over. But unlike the ordinary locomotive one or all of the driving boxes would be pretty warm. The waste in the cellars would then be shaken up, the lubricator filled, and they would try again. About thirty miles up the line a stop would be made, the boxes looked over and the warmest ones repacked. By this time some of them would be getting pretty hot, and these would be given additional treatment in the form of a generous amount of tallow on top of the waste. And so it would go up and down the line, always watching the driving boxes, repacking the warmest, and putting on tallow when one got real hot, the boxes cooling off one by one until finally all would run cool. Sometimes it seemed hopeless for one or more of the boxes ever to run right, and the locomotive had to go into the shop and have more work done on them. After several days or a week of running light and now and then pushing a coal train, the locomotive would be fit to start in passenger service.

The reason usually given for this trouble in breaking in the bearings is that the more uniform turning moment of the three-cylinder locomotive causes the axles to ride more steadily in the boxes and the lubricant does not get the chance to spread that it does in the case of the two-cylinder locomotive. A brief analysis of the stresses in such a three-cylinder locomotive shows that the stresses on the main boxes for a single axle locomotive alternate twice in each revolution, the same as a two-cylinder locomotive, but that this maximum is much less, and the build up more slow, so that the theory is probably correct. It seemed to me at the time, and I still believe that a different form of box with a different lubricating system would have enabled these locomotives to get into service as readily as any others. What is needed is a box where the oil does not have a chance to get off the bearing, as it does in a box with an open cellar, and fitted so that the lubricant is applied at the point of greatest pressure.

About this time some locomotives were built, designed, as I recall, for a 104,000-lb. piston thrust and a load per pair of driving wheels of 74,000 lb. Although having two cylinders, they developed the same trouble as the three-cylinder engines—they would not run on grease. Force feed oil lubrication was substituted with satisfactory results. These locomotives had hollow main shafts which, of course, contributed to their running hot, but a little thought reveals a strange condition in the driving boxes. The piston thrust is abnormally large, compared to the weight on drivers; the spread of the cylinders is more than twice the distance between frame centers so that at certain parts of the revolution the stress on the frames due to piston thrust will be about double the piston load, about 200,000 lb. in each frame; to this must be added the proportionate share of the tractive effort, making a maximum total of 220,000 lb. for one side of this locomotive. At the beginning of the stroke the side rods cannot be counted on to carry any of the load, and this full load will be thrown on the main driving box. The vertical load on this box probably is not over 32,000 lb. The ordinary form of driving box with which the locomotive was fitted has a bearing on the top side of the shaft only, and it is cut away for a half inch or so from the center line to help lubrication. Now notice what happens in this particular case. There is a horizontal thrust on the bearing of possibly 200,000 lb. at certain parts of the revolution. There is a vertical load of only 32,000 lb. The resultant of these two will be pretty nearly horizontal, and will hit the bearing only about an inch above the center line, or about ½ in. above the actual bottom of the bearing, and the whole load is being carried on a narrow strip at the bottom. The bearing instead of being the nominal 11-in. by 14-in. or thereabouts, is only 1-in. by 14-in., and the load, instead of 32,000 lb., is actually 200,000 lb. An adequate remedy would take the form of extending the bearing further around the axle, so that there would be bearing surface at the center line of the axle where the great frame load is applied.

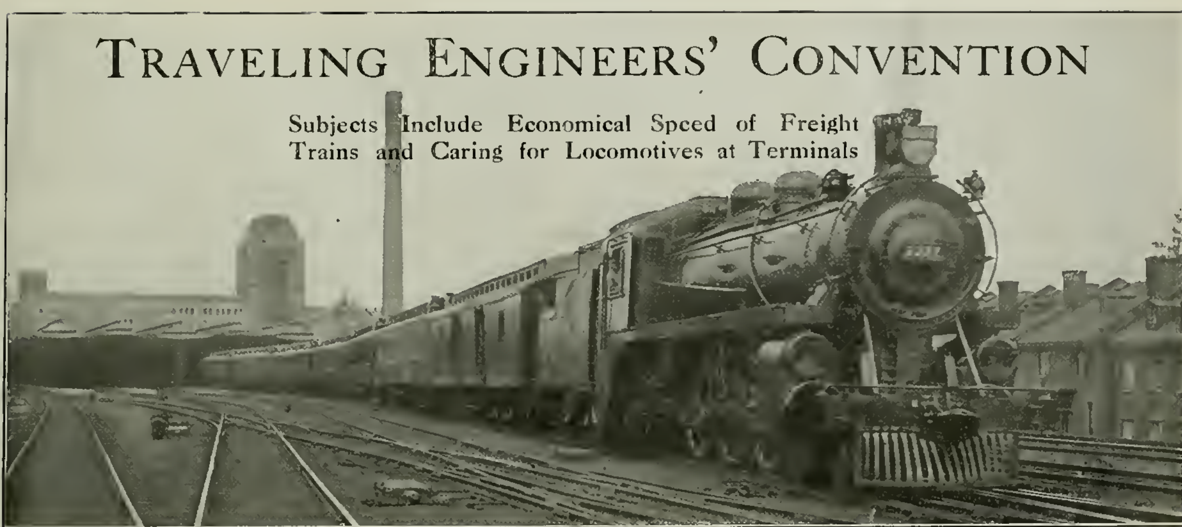
Such an axle box would have the bearing covering more than half of the shaft, which would mean that it would be made in more than one piece in order to get it off. There is no insurmountable difficulty in this and probably several solutions could be found. It would mean more machine work on the new box, but the maintenance should be less. Increasing the length of the journal to give more bearing surface will not give the same results, as there is very little bearing surface to increase, and increasing the length throws the frame centers nearer together, increasing the load on the bearing. For an engine with oil—and oil lubrication is more efficient than grease—a bearing of but two pieces, completely encircling the shaft would be the thing. This could be bored to a nice running fit and should last a long time. With oil lubricant a force feed lubricator, leading the oil to the proper point on the bearing, would seem most suitable. For grease lubrication the bearing might be made in three nearly equal pieces, or made in two pieces, one large and strong enough to have a cavity to hold the grease pad.

The conditions I have mentioned are, of course, excessive for a locomotive with only two pairs of drivers, but with a powerful locomotive having five pairs the condition must be much worse. With the ordinary form of locomotive full piston load is thrown on the main crank pin at the time it crosses the dead center, but the side rods do not carry any load until it is quite a way past, and for that time the main driving box must carry all the horizontal load on its side of the engine, which is more than it can do, as it is now constructed.

George L. Clouser.

Traveling Engineers' Convention

Subjects Include Economical Speed of Freight Trains and Caring for Locomotives at Terminals



C. P. R. Passenger Train Leaving Windsor Street Station, Montreal, Que.

THE Traveling Engineers' Association held its twenty-seventh convention at the Hotel Sherman, Chicago, beginning September 16 and closing September 19. Following the formal opening exercises the president, H. F. Henson, road foreman of engines of the Norfolk & Western, addressed the convention.

PRESIDENT'S ADDRESS

Mr. Henson spoke in part as follows: Our last convention met during the great world struggle and at that time all our attention was devoted to bringing the conflict to a successful conclusion. We have met the challenge of war. Now let us meet the challenge of peace and securely re-establish justice, loyalty and freedom. In these trying times labor cannot afford to put itself in the position of obstructing the wheels of progress. The workers must see that not only loyalty to their country but also loyalty to its industries is essential. The conservatism and loyalty of the traveling engineers has never been questioned and they can help to influence opinion among the many employees with whom they come in contact.

After referring to the present industrial unrest, Mr. Henson made a plea for rigid economy in the use of fuel and supplies on the railroads. In discussing the affairs of the association he mentioned that the American Railroad Association has invited the Traveling Engineers to amalgamate with it and asked the members to give this consideration.

COMMITTEE REPORT ON PASSENGER TRAIN BRAKING

The following is a summary of the report of the Committee on Handling Air Brakes on Passenger Trains.

Before coupling to the train the compressor steam valve should be opened wide, the steam end lubricator feed increased to about two drops per minute for each compressor having two steam cylinders, or one drop per minute for each compressor having one steam cylinder. To assist in charging the train quickly the brake valve should be placed on lap, the maximum main reservoir pressure accumulating. To charge the train quickly release position should be used until five pounds less than standard brake pipe pressure is shown on moving the valve to running position.

BRAKE TESTS

The report outlined the procedure for making the standing brake test and also contained instructions for a brake pipe test to be made if for any reason an angle cock or double heading cock had been closed at any time, to insure that all such cocks have been reopened. A running test to insure that the brakes can be operated from the brake valve must be made when the engines have been changed or at other times after the hose has been uncoupled or parted, also at a sufficient distance from drawbridges, railroad crossings or before going down heavy grades, so that the train can be stopped by hand brakes. The train should be left with a reduction of 20 lb. on the completion of a stop at terminals for the incoming brake inspection.

STARTING AND SLACKING

To avoid shocks, which are disagreeable to passengers and damaging to equipment, the committee recommends that where starting requires the taking of slack the throttle should be closed, the independent brake applied, the locomotive reversed and the engine brake then graduated off. Steam should be used if necessary to close in all train slack and if the train must be backed to a more favorable place for starting, the engineman should continue to work steam moderately until the stop is completed in order to have all slack closed in. The engine should then be reversed, the release of the brakes started and steam then used as carefully as consistent with starting the train, at the time when experience indicates that the holding power of the rear brakes is ending.

The independent brake should not be used in making passenger train stops.

SLACK CONTROL

Smooth handling of passenger trains requires that slack must never be changed suddenly and any heavy reduction should be avoided when speed is low; the split reduction should be used when commencing other than light applications. While applying brakes on trains of more than eight cars the use of steam should be continued, to hold the slack while the brakes are being applied where conditions will permit.

COMPLETE RELEASE

Sand should not be used while braking on good rails, except in an emergency. To completely release passenger train brakes the automatic brake valve handle should be moved to release position, back to running position and then, after waiting about seven seconds, "kick-off" should be made. The proper time in release position is indicated when the brake pipe hand shows five or six pounds more after returning to running position than before moving from lap to release, varying from a second with a very short train to more than 15 seconds with the longest train. A release should not be attempted unless the pressure has been reduced at least seven pounds below the standard carried if the train has less than eight cars, and ten pounds for longer trains.

STOPPING TRAINS WITHOUT GRADUATED RELEASE

Stopping without graduated release from usual speeds requires the two application stop. The application should be made while working steam and using the split reduction; a reduction of about 15 to 18 lb. should be made, depending upon speed and grade. Steam should then gradually be shut off. This application having been made at a point that will reduce the speed to 12 or 15 miles an hour when about 500 ft. from the stopping point, should be released and followed by a second application of about seven pounds reduction, avoiding a total of over 10 lb. if possible.

In stopping with the one-application method from slow speeds, sufficient time should be allowed between shutting off steam and starting the brake application to permit drawbar springs to react and start the slack in, thus avoiding the action of the slack and the brake application coming together and producing disagreeable shocks. Where the one application method is being used a split reduction should be made, at first not over six or seven pounds, followed by further reduction if needed. The first reduction should be early enough to avoid making a total application of more than 10 lb. when the stop is completed.

MOUNTAIN GRADE BRAKING

Retaining valves should be used on descending mountain grades whenever the brakes cannot be recharged to within 10 lb. of standard pressure. The application should be sufficient to insure a release, so that the train is retarded by the retaining valves and not by sticking brakes. Graduated release must not be used when retaining valves are cut in, and when retaining valves are not cut in, not more than one release graduation may be used between complete recharges. Limiting the maximum speed to 30 m.p.h. on grades of 3 to 3½ per cent, and 45 m.p.h. on grades of 2 per cent to 2½ per cent, provides for avoiding much of the trouble and annoyance from burned brake shoes and an average margin of safety compared to level grade work.

DOUBLE HEADERS AND PUSHERS

When a train is to have a helper locomotive coupled on, the regular enginemen will apply the train brakes with a 20-lb. brake pipe reduction before the helper couples on, leave them applied and close the double heading cock. The helper engineman after coupling, will release the brakes and make the brake pipe test. When a helper locomotive is to be cut off, its engineman will apply the brakes with a 20-lb. reduction and leave them applied. The regular engineman will then release them and make the brake pipe test. The automatic brake valve on other than the head locomotive must not be cut in at any time or for any reason except for a plainly needed emergency application of which the head engineman is unaware or unable to make.

With a pusher locomotive on the train, the head engineman will, when the train is to be started, allow the pusher engineman to endeavor to start it. When he is using full power the head engineman will carefully assist. When the train is being stopped, the pusher engineman will continue to use steam lightly until the stop to hold in the slack.

BACKING TRAIN MOVEMENTS

When ready to make a backing train movement in which the back-up hose will be depended on for more or less control, the engineman will lap the automatic brake valve on receiving the signal to back. The man at the rear end will make a sufficient discharge from the back-up hose cock to insure a substantial application of the brakes. On noting by the air gage and by the brakes applying that this reduction has been made, the engineman will make the usual release and proceed to back up. In such movements the automatic brake valve should be carried in running position, so that the brakes will release and recharge.

BRAKES STICKING

One cause of brakes sticking or failing to release is attempting to release a lighter application than at least 10 lb. Another cause is some brakes re-applying near the head end after releasing and a failure to make the "kick-off." Another cause is a defective feed valve which allows brake pipe pressure to vary from time to time, or a good feed valve that cannot regulate the pressure uniformly because of too little excess pressure, as a result of too low governor adjustment or a governor defect, or less excess pressure than indicated, due to an error in the gage.

[The report also took up the best methods of handling overcharged brakes of various types and the proper manipulation of the brake valve in the case of brake applications from an unknown cause.—Editor.]

The report is signed by T. F. Lyons, (N. Y. C.), chairman; Eugene Hartenstein (C. & A.); Fredric Kerby (B. & O.); L. S. Ayers, and W. R. Garber (K. & M.).

DISCUSSION

Mention was made of the use of gas engine oil for lubricating the air cylinders of locomotive air compressors, and L. P. Streeter (I. C.) stated that while good results had been secured with automatic lubricators on regularly assigned engines, some difficulty had been experienced in securing successful operation where locomotives were pooled. F. B. Farmer (Westinghouse Air Brake Company) expressed the opinion that a maximum speed of 45 miles an hour on descending grades was too high. In reply, G. H. Wood (A. T. & S. F.) stated that trains could be brought to a stop on descending grades from a speed of 45 miles an hour in the same distance that they could be stopped on level track from 65 to 70 miles an hour and for that reason there was no more danger involved. Where cast iron wheels were used the high rate of speed might result in extensive heating of the wheels and in that case it would be necessary to limit the speed.

ADJUSTING TONNAGE FOR AVERAGE SPEED OF TWELVE MILES AN HOUR

A railroad is most efficient when it produces the maximum ton miles per hour at the least expense consistent therewith. Engine efficiency should not be measured only by the percentage of possible tonnage handled per train, but preferably by the percentage of the maximum ton miles which can satisfactorily be handled per engine per month. Prof. W. J. Cunningham has well said:

"The time element has not generally been given the recognition it deserves. Ton miles per train hour as a unit is analogous to the horsepower unit, but instead of foot pounds per minute we use train ton miles per hour. . . . .

"A large part of the expenses vary with the hours, hence it is important that the ton miles per hour shall increase. The capacity of the road in periods of peak-loads of traffic will vary with the ton mile production per train hour.

"The ultimate unit of freight car efficiency is: 'Net ton miles per car day.' . . . We are all familiar with the reasons which make it difficult to get a larger daily mileage, but sometimes it may appear that we have become too complacent in accepting these reasons as a complete explanation. In times of car shortage, an increase of one car mile per day throughout the country would be equivalent to adding about 100,000 cars to those available for service."

Apparently this condition can be but slightly improved by increasing the speed of freight trains, because of the small percentage of the time that a car is in movement. But in this we may be deceived to a considerable extent, for in hundreds of instances which have come under the observation of every experienced railroad man, a small increase in the running time of a train has resulted in the loss of a car day for each car in the train at destination, and frequently an aggregate loss of many car days, as well as per diem charges (which may again interest us soon) at intermediate stations, terminals and junctions. An increase in the time on road also means less time at terminals for repairs, or fewer trips per locomotive. Continued exhaustive strain on locomotive parts is expensive, as such usage invariably results in failure or excessive repair work and time out of service, which, in addition to the direct expense, necessitates an increase in locomotives owned or under lease.

Generally the fuel consumed per ton mile is reduced as the engine load is increased within a reasonable limit, but the wages per train crew per trip are increased in most instances, and frequently it has been found expedient to reduce train tonnage much below the possible maximum in order to clean up blockaded divisions and thus to best serve the public as well as the stockholders. Solely on a ton mile per hour basis a gradual gain in locomotive efficiency can be shown as speed increases to thirty or thirty-five miles per hour; but when the speed of freight trains averages more than fifteen miles per hour, many factors other than ton miles per hour affect the net economy.

The probability of costly delays and accidents increases very rapidly as the length of train approaches the present maximum. The modern locomotive usually can keep a train moving which it cannot start without running out the slack with such force as to overstrain even the best draft gears and couplers.

The probability of failure of trains to make expected movement, with consequent expensive road and yard congestion, increases rapidly as train tonnage closely approaches the possible maximum, even though there is no breakage.

The modern locomotive attains its maximum fuel and thermal efficiency at speeds of not less than twelve miles per hour while working at approximately 25 to 30 per cent cut-off. As the cut-off is increased, the thermal efficiency decreases rapidly. At lower speeds, high degree superheated steam is not obtained, and the possible economy from this source is not realized. Superheater locomotives are capable of higher sustained speeds than saturated steam engines capable of dragging the same load, and full advantage should be taken of this superiority. On low grade divisions where it is necessary to half stroke or in many instances to nearly full stroke the engine most of the way between terminals, these features are worthy of careful consideration.

Fully as important as any of these considerations is the psychological effect on the train and engine crews. Delays or depressingly slow movement exhaust patience and interest, and without interest and initiative on the part of engine and train crews the best performance cannot be obtained.

Aside from the psychological effect on employees, the time element in calculation of wages of train crews, at one time negligible, has become of great and increasing importance during the past few years. Speaking generally, shortening the distance between terminals, with the cost of consequent new terminals and abandonment or lessening in productiveness of many present terminal facilities, would increase charges to capital account and operating expenses excessively.

On a railroad handling many high-speed and important passenger, express and mail trains on the same tracks used by freight trains, the maximum possible tonnage per train will result disastrously; while on roads having four tracks, for example, a closer approximation to maximum possible tonnage may be satisfactorily maintained. Often on single-track roads where sidings are five or six miles apart, it is with difficulty that trains can make one hundred miles within the sixteen hours unless the average speed exceeds twelve miles per hour, excluding delays.

The committee is of the opinion that the volume and character of traffic, the physical characteristics of the roadway, and the locomotive equipment vary so greatly on the several roads and in many instances on the various divisions or sections of the same system, that the problem of determining the most suitable average speed and tonnage for freight trains generally must be solved for each division or district. Numerous carefully conducted road tests and expert analysis of performance and cost records should be made to determine the most economical operation.

We believe that with very rare exceptions an average speed of more than twelve miles per hour for tonnage freight trains can be attained and maintained without reduction in the properly determined maximum allowable tonnage, and that this tonnage will exceed the present rating in some instances, if the transportation and mechanical departments co-operate effectively in determining the proper rating, and if the officers of these departments, as well as those in the maintenance of way department, put into regular use every possible means for the elimination of delays.

[A table was included in the report showing the average freight train speeds maintained by 23 roads over a period of 10 months. With three exceptions these were all less than 12 m. p. h., the arithmetical average being 10.8 m. p. h.—Editor.]

The report was signed by H. C. Woodbridge, chairman, E. F. Boyle, J. S. Meidroth and F. R. McShane.

A. F. Henson (N. [illegible]
President

J. A. Kell (G. T.)
First Vice-President

W. O. Thompson (N. Y. C.)
Secretary

Discussion

Several members spoke on the necessity for co-operation between the traveling engineer, trainmaster and despatcher in order to reduce delays and increase the average speed of trains between terminals. The prevailing opinion was that there is little danger of overloading locomotives if the main journal bearings are kept in good condition.

THE ADVANTAGES OF STOKERS ON MODERN LOCOMOTIVES

Heretofore, in considering the application of mechanical stokers to locomotives we have thought in terms of the present only. The time is now at hand when we must consider future needs. Man power and wage costs are the dominating factors, and for economical operation we must use machinery to do work that at one time could profitably be performed by hand. The economical rating of a locomotive is no longer the greatest tonnage it can haul over a division regardless of time, but the greatest tonnage it can haul over a given distance in a given time.

Ever-increasing wages makes it necessary to get more work out of the machines, and we can no longer limit the capacity of the modern locomotive to the capacity of the fireman to shovel coal.

The advantage to be gained by the application of stokers is the realization of maximum boiler capacity, not only through sustained periods, but at any time when needed. The necessity for using mechanical devices arises, not only from a humanitarian standpoint, but more particularly to develop 100 per cent efficiency in each individual, and as this factor enters into the effectiveness of the locomotive more than any other part of railroad operation, it would seem to be the strongest recommendation for the installation of mechanical stokers on all power that is kept in road service.

Years ago the capacity of the firemen at times governed the amount of work performed and not the capacity of the locomotive. There were two reasons for this: First, it is impossible to educate any two men up to a point where they will fire a locomotive exactly the same under all conditions and look ahead to be prepared for any emergency; second, the physical capacity of men to perform the work. The stoker makes it possible to have every engine 100 per cent effective. In some instances it is possible to get full capacity out of the locomotive, while in other instances, even with experienced men, it is not. Therefore it is only fair to assume that the amount of work performed by any given number of locomotives in any given territory will be based on the average poorest firemen on that division rather than on the average best firemen. With the engines equipped with mechanical stokers, receiving proper attention at terminals and by the men on the road, each will give practically the same service.

There is no question but that a scientific job of firing largely affects steam chest temperatures when using superheated engines. By some tests conducted on a superheated engine it was demonstrated that it was possible to increase the steam chest temperatures from 20 to 50 deg. by expert firing, as compared with the work of the regular fireman on the job. Uniform temperatures in the fire-box, together with perfect combustion, will give the highest steam temperatures possible to obtain, and as it takes a given amount of air to produce perfect combustion from a given amount of coal, and as the admission of air to the fire-box can only be regulated by the depth of the fire on the grate, it can readily be seen that in firing an engine by hand where the fire-door has to be opened to admit of the fuel charges, that the admission of air to the fuel bed through the grate must be intermittent, either too much when the door is closed or not enough when the door is open.

The stoker makes it possible to carry the water at a lower uniform level than with a hand-fired engine, for the reason that the steam pressure can be maintained at any time even though the engine is being worked to its maximum capacity through any sustained period.

In all the comparative tests that have been made between the stoker and hand-fired engines no one seems to have come to the same definite conclusion regarding fuel consumption. We have found that in using the same grade of coal with the stoker and hand-fired engines, the boiler capacity of the engine not only is increased to a great extent as far as handling tonnage is concerned, but that it materially reduced the running time between terminals; therefore, with the present stoker in its perfected form, it should not only show much greater efficiency than a hand-fired engine, but also effect a very material reduction in fuel consumption.

Considerable stress is placed on the stack losses of stoker-fired engines due to the extremely fine quality of coal necessary to use on them. With the present perfected stoker and the brick arch extending well back to the door sheet, the stack losses can be reduced to a point nearly as low as is done by using run of mine coal hand fired. In some large Mikado type engines, where originally they used six bricks in the arch, the arch was extended up to within about seventeen inches of the crown-sheet. This not only has made a saving in stack losses, but almost entirely eliminated the smoke. With an arch of this kind and a large combustion chamber it would be possible with careful manipulation to burn 98 per cent of all fuel in the fire-box.

The firemen are demanding another increase, and in addition are requesting that all engines above a certain limit be equipped with mechanical stokers, and all under that limit be equipped with mechanical coal passers and grate shakers. Considering the cost of the mechanical coal passer and grate shaker, it would be much better to take the money expended in this way and equip all engines kept in road service with a stoker.

While committees reporting on this subject in the past have never been able to secure reliable information, records for the past five years show our maintenance cost to have been a little under $10 per thousand miles. As to engine failure due to stoker trouble, the records of the El Paso & South Western show an average of 61,556 miles per stoker failure. The application of stokers on this line has entirely eliminated the stereotyped engineers' report of "engine not steaming." As a rule the size of nozzles has not been increased, but it has been possible to adopt a standard front end and make all engines give a uniform service as far as steaming is concerned. It was never possible to get any class of engines to steam alike when hand fired. One fireman would want a bridge in the nozzle, while another wanted it out; one would want the draft-sheet 15 in. from the bottom of the arch, while another wanted it 21 in.; one would want the petticoat adjusted one inch above the nozzle, while another man would want it six inches. With the stoker, however, practically no work on front ends is necessary by the roundhouse force except to make regular inspections.

Owing to the constantly increased coal burning capacity of the locomotive, the application of a mechanical means of supplying the fuel is the only thing that will make the work sufficiently attractive to get and keep the right kind of men on our engines.

The report was signed by E. Gordon, chairman, J. A. Cooper, A. N. Willsie, J. O. Clendenin and J. R. Bissett.

HANDLING LOCOMOTIVES TO SECURE EFFICIENCY AND FUEL ECONOMY

The essential requisites to locomotive efficiency are proper design, proper operation and proper maintenance of power, the matter of fuel economy always being closely related to any of the three. The matter of proper design should start with having the boiler and grate area designed of ample proportion to furnish enough steam to develop the maximum cylinder horsepower of the cylinders at all times. Every modern locomotive should be equipped with superheater, brick arch and power fire-door; all of which are fuel-saving and capacity-increasing devices. The combustion chamber also makes for fuel economy and is now in successful use on most large locomotives. The mechanical stoker should be applied to all large engines, and although the conditions under which the engine is to operate would govern, generally speaking, engines with over 50,000 lb. tractive power ought to be stoker fired.

Air compressors and headlight turbines of modern and most economical design should be used on new power, and on some old power it will be found in the interest of economy to replace existing auxiliaries with the more economical outfits. There are some as yet undeveloped sources of fuel economy for locomotives, one of which, the feed water heater, while still in the experimental stage, will undoubtedly soon be perfected and put in more or less general use.

In designing the engine, front end, grates and ash-pan should be given plenty of attention. It is necessary to keep the air out of the front end, and yet admit it in plenty to the ash-pan, which means ample ash-pan air openings and all joints tight around the front end. The exhaust nozzle should be made as large in diameter as possible, so as to reduce back pressure and yet furnish the draft required to produce proper action on the fire. The grates should have ample air opening and the grate rigging should be such as to permit shaking freely by the fireman, which cannot be done if too many sections of grate are carried on one shaker.

ESSENTIALS FOR PROPER OPERATION

It is recognized that where locomotives are pooled they are not so well maintained, as the engine crew does not take the same interest in an engine that they may not see again for a month; and they do not make the lighter repairs, nor the thorough inspection and report of defects en route which they do in a case of the regularly assigned engine. Although it may be more economical in general to use pooled engines, particularly when business is heavy, there are instances where regularly assigned engines could be used, and it is preferable to do so when consistent.

Locomotive performance is affected to a considerable extent by the terminal facilities. Terminal facilities may often include various fuel or labor-saving appliances, but these are not always installed in co-ordination with other appliances at the same terminal. Proper terminal layout should be such as to get the quickest movement into and out of the engine-house of engines arriving at and departing from terminals. Considerable fuel is lost, the expense of handling the engine increased, and there are many delays due to improper design of terminals.

Wherever it is possible to change an existing water supply for one of better quality, it should be done, providing the cost of the change is not prohibitive, and then, having obtained the best available water, every water should be given the necessary treatment to prevent scale formation and corrosion within the boiler. Fuel lost from having scaled heating surfaces is a large expense; boilers operate at reduced efficiency when sealed up; engines fail and give up trains on account of flues leaking, and the cost of boiler maintenance is much higher on account of frequent flue, stay-bolt and firebox renewals. Engine failures due to leaking can be reduced to practically nothing; staybolt trouble can be reduced to a minimum, and considerable fuel will be saved with the proper treatment of all waters.

MAINTENANCE OF MACHINERY AND BOILER

Proper maintenance depends first on proper inspection and then on getting the defects corrected which are brought out by this inspection. The pooled locomotive can be run successfully and efficiently if there is adequate terminal inspection and repair. Not infrequently the officer in charge of the terminal is under the impression that the only inspection necessary is searching for loose nuts, missing parts of machinery, cracks, hot bearings, etc., and consequently uses rather low-grade men for this purpose. The best man on the job is none too good for inspection, as a locomotive ought to be tested for steam blows, pounds and such defects as cannot be observed by the eye alone.

If the inspection and repair of locomotives were carried out in accordance with federal inspection laws good results would be secured. All repairs found by the inspector ought to be made, and when possible a check should be made before the engine leaves to see that all work has been done.

A few items of maintenance, or shop practice, that might be mentioned are care in laying out shoes and wedges, and proper maintenance of binders, tramming of engine trucks, drivers and tender trucks, and the fastening of valve bushings so that they cannot move, making it possible to use standard rings for all engines of a class. It will frequently be found that the steam distribution is not correct for engines of the same class, due to slight differences in the position of the valve bushing and size of valve rings used.

Perhaps one of the most important items of maintenance is the proper care of superheaters and superheater flues. The superheater is the greatest fuel-saving device, and as the saving in fuel depends on the amount of superheat, it follows that any obstruction which prevents free passage of the hot gases around the superheating units will result in a reduction in superheat and a corresponding reduction in the efficiency. It does not take many trips for superheater flues to become stopped up and unless constant attention in the way of blowing them out in roundhouses is given superheaters will be found only saving perhaps 50 per cent of what they should when properly maintained.

FUEL DEPARTMENT ORGANIZATION

Although fuel economy depends on proper design, proper operation and proper maintenance of power, it is necessary in order to get real results to have a separate fuel organization. This should consist of a general staff officer, in charge of fuel conservation, who should devote his entire attention to the conservation of fuel on locomotives, in shops, at terminals, water stations and for all miscellaneous purposes. He should also have jurisdiction over the quality, preparation and uniformity of coal furnished.

To carry out his plans, the general fuel officer should have divisional fuel supervisors, who should be assigned a certain territory for all the various details of fuel economy, but whose principal duty should be the education of firemen in the economical firing of engines. The fuel organization should have enough clerical assistants to keep up-to-date records of fuel performances by individual engine, by engineer and by fireman, so that performances on any division can be known and examined at any time. These records give means of locating the cases where an engine or an engine crew is operating wastefully, and they also show what progress is made in saving fuel.

Monthly divisional fuel meetings should be held with the superintendent, master mechanic, divisional officials and such employees as can consistently attend. General fuel officials should attend these division fuel meetings as often as possible, but the superintendent should be the chairman of the divisional fuel committee and conduct the meetings, as this brings about a more thorough and more uniform understanding of the importance of various matters effecting fuel economy by operating officials who otherwise might overlook some of the details and leave it up to the mechanical department.

Any progressive movement must be backed by educational efforts and great stress is laid on the necessity of constant education of enginemen particularly, as they, of all employees, are most responsible for the coal pile, and also of all others who in any way may be concerned in the use or waste of fuel.

The report is signed by J. B. Hurley (Wabash), chairman; Robert Collett (U. S. R. A.); F. P. Roesch (U. S. R. A.); B. J. Feeny (U. S. R. A.); and G. E. Anderson (Gt. Nor.).

DISCUSSION

W. G. Wallace (American Steel Foundries) emphasized the importance of having a record of the coal consumption immediately available at the end of each trip. If this information is given to the train dispatcher at the end of the run, it makes it possible to check up the coal consumption, taking into account all the conditions surrounding the trip. This helps greatly in fixing the responsibility for excessive fuel consumption, whether it is due to the operating conditions, the mechanical condition of the power or the quality of the coal. E. Hartenstein (C. & A.) mentioned the losses due to slow orders and unnecessary stops. He also touched on the qualifications of locomotive inspectors and stated that men who had received their training in road work were often better qualified than men from the shop. V. C. Randolph (U. S. R. A.) called attention to the important part which the locomotive engineer must play in securing economy in the use of fuel, and advocated that these men should be taught how to operate the engines at the greatest efficiency. Among the common wasteful practices he mentioned especially working the locomotive harder than is necessary. H. C. Woodbridge (U. S. R. A.) stated that irregular action of reverse gears was often responsible for excessive fuel consumption and expressed the opinion that it is necessary to make improvements in these devices. A. G. Kinyon (Fuller Engineering Company) advocated a fuel department organization reporting to the chief executive officer. He brought out that instruction must be supplemented by adequate supervision to get the best results. B. J. Feeny (U. S. R. A.) stated that too much attention is given to accounting for oil and far too little attention to fuel records. He also emphasized the fact that the responsibility for saving fuel extends to all departments.

CARING FOR LOCOMOTIVES AT TERMINALS TO SECURE EFFICIENCY AND INCREASED MILEAGE

Assuming that locomotives come from the shops in condition to readily develop the state of efficiency for which they are rated, the efficiency that can thereafter be maintained and the milage obtained, will depend largely upon the thoroughness of the work done upon the locomotive during general overhauling periods. The limited facilities of the average terminal plant should not be required to make good the shortcomings of the general repair shops.

Increased mileage is but another term for maintenance of a high efficiency, as it presupposes less delay along the line due to locomotive troubles, quicker turning at terminals for service and a greater number of trips between shoppings. The efficiency of the practices in use at terminals, the extent of the facilities available for doing work and the excellence of the work done will in a general sense determine the measure of efficiency that can be expected to be maintained at such places. It follows that a constant striving for the betterment of practices, of facilities and of workmanship, are the essential needs at terminals to maintain locomotives in an efficient state and to increase the mileage obtainable. The traveling engineer should be of valuable assistance to those in charge of terminals in bringing these betterments about.

The question as to what are the best methods of caring for locomotives at terminals is synonymous with, what constitutes good roundhouse practice?

Studied from any angle, these two questions constantly intermingle and seemingly resolve themselves into the identical set of fundamental requirements which, in turn, constitute equally the basic principles of good roundhouse practice and of locomotive maintenance.

These requirements are: Caretaking inspection of the locomotive by competent locomotive inspectors as soon as possible after arrival at terminal; the obtaining of an intelligent report from the incoming engineer as to the conditions noted during his trip; the proper cleaning of the fire, ash-pan and front end, and attention to the fire and water while lying at the terminal; a careful inspection by competent workmen of the troubles and defects as reported by the engineer and locomotive inspectors and the making of the necessary repairs and changes in an efficient manner; the furnishing of the proper engine tools and the necessary supplies for the outgoing trip, which will include filling of lubricators and rod cups; frequent riding of the locomotives by the traveling engineer.

With the exception of the last mentioned point, these requirements are incidental to every trip in either direction where inspection and repair facilities are provided for at each terminal. The maintaining of efficiency demands that these requirements must be provided for and carried out at least at the end of each day's work, and is required by the Interstate Commerce Commission rules.

In addition to the points already mentioned, provision should be made for periodical inspections not usually covered in work reports, which will include boiler washing, boiler inspections and inspections of the operating parts enumerated later on; for the carrying in stock of needed supplies of all kinds for making the repairs and for renewals, and for shop equipment and tools necessary for reasonable running repair maintenance.

ENGINEERS' REPORTS

As there are certain troubles and defects such as steam blows, pounds, and conditions affecting the steaming properties, which are only discernible when the locomotive is working, an intelligent report from the engineer as to the conditions noted while running on the road, is of the greatest importance.

There is scarcely a way in which the traveling engineer can be of more use to the mechanical department and be of greater aid in assisting to keep locomotives in an efficient condition than in seeing that engineers' work reports are made out in such a manner as to clearly indicate the nature of the defect, and in cases where a definite cause cannot be given describe just what takes place.

LOCOMOTIVE INSPECTION

The Locomotive Inspection Bureau of the Interstate Commerce Commission has issued rules governing the inspection of locomotives, and including limitations of wear permissible for certain parts. These rules are based upon the practical experience of both the federal inspectors and representatives of the most important railroads of the country, and failure to live up to them constitutes a violation of the law.

Carried out in the spirit intended, they stand for good maintenance. Where observed, however, only within the letter of the law, a high state of efficiency is not necessarily indicated, as many of the rules do not cover the best conditions obtainable, but rather the poorest allowable, and the limitations below which it is not permissible to go. The inspection should be thorough and painstaking, inasmuch as defects that result in delays, breakages and failures, are quite frequently discernible only under the very closest scrutiny.

In addition to those parts covered by the rules, every part subject to wear that would interfere in any way with the efficient working of the locomotive and all parts subject to severe strains, breakages, or loosening effects, including nuts, keys and cotter pins, as well as the condition of all safety appliances, should receive attention. It is a good plan to have an outgoing inspection, covering conditions of air brakes, injectors, electric headlight, and power reverse gear, and for the examination of such parts of the locomotive as were reported for shop attention.

Where for any reason the fire is dumped at the terminal, suitable provision should be made for the inspection and testing of steam and air-operated devices, such as the air brakes, injectors, electric headlight, power reverse gear and similar devices, while still under sufficient steam pressure to operate such parts. This guards against defective conditions in such parts, gives opportunity for repair if any defects are found, and in the case of air brakes, provides for the testing and the adjusting of the piston travel within the proper limits.

All locomotives should be cleaned in order to facilitate the work of inspectors and shop men.

SHOP FACILITIES AND TOOLS

Where the facilities of a general or so-called back shop are not readily accessible, adequate means for doing light repair work of a reasonable nature should be provided in the way of a small machine and blacksmith shop. This should contain at least a lathe, a small shaper, a drill press, a press for pushing bushing in and out, a blacksmith forge and a grindstone. Such a plant is almost invaluable, providing for both quicker and better work as well as assisting in cutting down the cost of maintenance. A supply of tools such as drills, taps, reamers, dies, files, wrenches, pipe fitters' and boilermakers' tools and others not usually provided by the workmen themselves should be at hand.

The weight of various parts which have to be handled demands the use of portable cranes, jacks and block and fall, and these should be provided for quick and safe work. An electric or other type of welding machine has also become a necessity in terminals of any size.

SUPERVISION, QUALIFICATION AND METHODS

Competent supervision over mechanical activities at terminals is a most important factor in efficient locomotive maintenance. Men for these positions should be chosen with particular regard for their experience, good judgment, foresight and resourcefulness, as well as for their ability to handle men. Frequently located at points distant from any large terminal through which immediate assistance could be procured, often with poor facilities for doing work and none too competent help, their success or failure depends largely upon their own capabilities.

Resourcefulness is necessary in devising ways and means to meet the varying conditions incidental to running repair work and the emergencies that are constantly arising. The interest taken in the work by the supervision will be a dominating feature in the results achieved. Not only should the workmen be watched to prevent loose methods and bad practices creeping in, but the completed work should be frequently examined as a guard against poor work and carelessness.

TURNING POWER

Features other than the maintaining of an efficient locomotive enter into the matter of increased mileage and as they have to do with the care of the locomotive while at terminals, they must be given due consideration in connection with terminal work.

Increased mileage necessarily implies a greater number of trips to be made between shoppings and conditions at terminals which interfere with the promptness with which locomotives may be reached for the purpose of making needed repairs and prepared for a quick return to service, tend to prevent increased mileage.

It is usual to consider the cleaning of fires, the obtaining of coal and water and the turning of the locomotive as adjuncts to the maintenance and care of power. The provisions made for doing this work and the ease with which the locomotive can reach the points where the work is to be done, is most important in the quick turning of locomotives as a means of bringing about increased mileage. Inadequate provision in this respect slows up terminal movements, hinders prompt repairs, tends to hurried repairs and to work being left undone. It frequently leads to badly congested conditions and serious delays, and fosters carelessness in the various stages of preparing the locomotives for return to service on account of the necessity of crowding them through the terminal in order to turn them with any degree of promptitude, and in general results in poor conditions and delays.

Poor facilities in this respect are especially troublesome at terminal points where severe winter weather is experienced and during such periods they may be the cause of power conditions becoming very serious.

The trackage about terminal plants insofar as it provides for prompt and free movement of the locomotive in conjunction with cleaning fires, obtaining coal and water, getting to and from the turntable and in reaching and departing from the shop, is important in giving more time for the making of repairs and lessening the time required for preparing the locomotive for dispatching. In a like manner the adequacy of the provisions made for cleaning the fires, for inspection purposes and for coaling, have an important bearing on the time necessary in getting the locomotive ready for service.

RESPONSIBILITY OF THE TRAVELING ENGINEER

The duties of the traveling engineer place upon him a considerable share of the responsibility for the maintenance of the locomotive over which he has nominal control. Being in constant touch with all the conditions that enter into their handling both at the terminals and on the road, he cannot well evade such responsibility.

In various ways, as casual inspection of methods used and work being done when he is around terminals, riding the locomotive, investigation of delays and failures and through his contact with the locomotive crews, it is within his power to know just what conditions are. He has the means of knowing whether his engineers are making intelligent reports or not by occasionally looking over their work reports. He has the means of knowing by personal observation and by information gained from delay and failure reports whether inspectors are competent and painstaking in their work or not. He should know whether or not fire, ash-pan and front-end cleaning is being done properly, and the locomotive cared for in a proper manner while laying over. He should know by the results obtained as well as by the complaints of the locomotive crew, by his personal experience in riding and by results of investigation of delays and failures whether the work being reported is being properly done or neglected. He can easily ascertain what is done with reference to boiler inspection during boiler washing periods and to other parts during periodical inspection.

In the extent to which he avails himself of this information, and the use to which he applies it will lie the measure of his share of the responsibility for the conditions which exist. It is scarcely sufficient that he is able to say in explanation of poor conditions that the work required to better conditions was reported. He must be able to show that he made use of all the means within his power to bring about a betterment of conditions. It comes well within the scope of his authority to consult and advise with those in charge of terminals as to conditions that are detrimental to maintenance and efficiency.

He will almost invariably find that the information and advice that he can offer will be most gladly received. As a rule the terminal authorities are more given to complaining of the lack of assistance given them by the traveling engineer than in regard to his insistance on better conditions.

The traveling engineer should take particular interest in the prevention of practices which tend to decrease locomotive efficiency, such as moving engines without opening the cylinder cocks, with its ill effects on cylinder and piston rod packings and the slipping of locomotives in starting them, with its general racking strains.

The report is signed by T. F. Howley, chairman, Joseph Keller, B. J. Feeny, C. W. Corning and J. W. Burrows.

DISCUSSION

W. H. Gallagher (M. K. & T.) advocated a method of adjusted tonnage rating as a means of securing greater efficiency from locomotives. E. R. Boa (N. Y. C.) brought out the necessity for cooperation between the traveling engineer and the roundhouse foreman. F. L. Pierce (C. & A.) described a method of inspection of outgoing engines by traveling engineers which had brought good results. E. F. Boyle (So. Pac.) spoke of the damage to locomotives resulting from improper operation by hostlers, who often moved the engines when cylinders were filled with water. B. J. Feeny (U. S. R. A.) stated that while good facilities were necessary to secure the best results, a fair degree of efficiency could be secured by giving attention to simple matters which required no elaborate equipment, such as blowing tubes and cleaning grates, as these matters have a great influence on the operating results secured with the engines. W. L. Robinson (B. & O.) mentioned the abuse of locomotives by incompetent hostlers, and stated that traveling engineers should have authority over these men and should instruct them in the proper method of handling engines. E. S. Boyle (So. Pac.) stated that, as a rule, if all the work reported by the enginemen is done, the motive power will be kept in fairly good condition. It is, however, necessary for the traveling engineer to see that the men do not fail to report necessary work. He advocated occasional joint inspection by the traveling engineers, general foremen and master mechanics to check up the engineers' reports. A resolution was passed stating that in the opinion of the association there should be responsible engine inspectors and night roundhouse foremen at all engine terminals.

OTHER BUSINESS

At the session held on Friday, the report of the committee on amalgamation with the American Railroad Association was received and discussed. The committee stated that in view of the fact that the duties of the traveling engineer were not strictly mechanical work nor transportation work, but a combination of the two, it believed that the best results would not follow from amalgamation as a division of either the operating section or the mechanical section, but by the creation of a separate section to take over the activities of the Traveling Engineers' Association. This course had been suggested to the officers of the American Railroad Association, but no answer had been received, and in view of this situation the committee was continued.

The by-laws of the association were amended to leave the selection of the place of meeting entirely in the hands of the executive committee.

The following officers were elected: President G. A. Kell, Grand Trunk; first vice-president, W. E. Preston, Southern; second vice-president, L. R. Pyle, Railroad Administration; third vice-president, E. Hartenstein, Chicago & Alton; fourth vice-president, J. H. DeSalis, New York Central; fifth vice-president, E. F. Boyle, Southern Pacific; secretary, W. O. Thompson, New York Central; treasurer, David Meadows, Michigan Central; members of executive committee, F. P. Roesch, Railroad Administration; B. J. Feeny, Railroad Administration; J. Keller, Lehigh Valley.

FRONT ENDS, GRATES AND ASH PANS*

During the past few years much attention has been given to results obtained from the performance of heavy Mikado and Santa Fe type locomotives. The committee felt that an analysis of some of the apparatus pertaining to the designs of front ends, grates and ash pans was pertinent, and accordingly sent a letter to the mechanical engineers of some of the larger railroads of the country, reading in part as follows:

"In connection with work by the Standing Committee on Front Ends, Grates and Ash Pans of the International Railway Fuel Association, we wish to compile data in regard to improvements in designs of front ends, grates and ash pans which some of the more important railroads have found to produce a saving in fuel. We would like to have this data in connection with the larger type locomotives, preferably the Santa Fe or the Mikado types.

"If your railroad has found a change in design within the last two or three years which is proving to be a more economical design than you originally had on front end arrangements, on grates or on ash pans, also if the designs you now use are giving very good economy, will you please send drawing showing the old and new designs and also advise as to the size of the locomotive, the class of service, the grade of fuel burned and any further information which you see fit to give regarding both old and new designs."

The response to these letters, together with information submitted by individual committeemen, has suggested a comparison of present practice with the practice of some fifteen years ago, particularly in reference to front end design when the Master Mechanics' Association in 1906 endorsed the Purdue University tests on front ends.

The fundamental principle of the Master Mechanics' standard front end is that the height, H, of the portion of the stack extending above the smoke box and the distance, h, that the exhaust nozzle is below the horizontal center line of the smoke box be, for best results, as great as practicable. This being done, dimensions of certain importance are ascertained in accordance with the following formulae in which D is the diameter of the smoke box, P the distance the stack extends below the top of the smoke box, d the diameter at the choke of the stack, b the diameter of the base of the stack, and h the distance from the base of the stack to the choke or smallest dimension of the stack.

$$d = .21D + .16h$$
$$b = 2d \text{ or } .5D$$
$$P = .32D$$
$$p = .22D$$

It is to be remembered that the diameter of the smoke box on which tests were made in establishing the design factors for the standard front end was 74 inches, and that the maximum back pressure of the exhaust blast that produced the draft on this oil-burning locomotive was only a little more than 4 pounds. These are conditions which do not prevail in general practice today. The diameter of the smoke box on the majority of larger engines is from 80 to 91 in. and the back pressure is far in excess of a maximum of 4½ pounds.

The function of the stack is a very important one in its relations to the drafting of the locomotive and its fuel economy. The diameter at the choke of the stack, as determined by the standard formula, is made a function of the diameter of the smoke box, as well as the distance of the exhaust nozzle below the center line of the smoke box. The question arises whether or not this is a proper basis of design with present-day practice with large locomotives, either using saturated or superheated steam, hand fired or stoker fired. Is this the proper equation to give maximum fuel economy? Does it

*Abstract of a committee report presented before the International Railway Fuel Association at the convention held in Chicago, May 19-22, 1919.

give a stack that is large enough to take care of the exhaust steam and the exhaust gases and to deliver them properly and with such a degree of freedom that good fuel economy results?

By comparing the formulae with the practice on present prominent railroads, we find that the maximum calculated diameter of the stack at the choke is 23 in. and that the actual diameter is 21 in. In this case the minimum area of the actual stack is 17 per cent below that required by the formula; no data have been established by experiment on this coal-burning Santa Fe type superheater locomotive to show that a 23-in. or larger stack might not be used.

This railroad in question is notably a leader in the large size of its stacks. Another railroad in an adjacent territory is using a 17-in. stack on this same type of locomotive.

An analysis of all the design dimensions referred to by the formulæ is of great interest as a matter of comparison, and one might possibly draw the conclusion that the dimensions were made to suit other conditions and not made to follow the formulae in that they vary as much as 100 per cent in several instances.

What, then, is the state of the standard Master Mechanics' front end? It may possibly be expressed in the words of a prominent mechanical engineer when he said recently: "So far as present large power is concerned, there is no such thing as a standard Master Mechanic front end. On present-day power, using superheater steam, the arrangement will not permit such a front end."

The Master Mechanics' front end did not provide a front end netting which is common to most locomotives of today, so located as to extend from the table plate at an angle of about 40 degrees to the forward part of the smoke box. This location of the netting for interception of the exhaust gases makes accessibility of the front end rather difficult, and many designers have expended their efforts in developing a different arrangement of the netting or spark arrester.

The Chicago and North Western has had for several years a box arrangement known as the Slater front end which is claimed to give very satisfactory results. The Burlington has an arrangement differing widely from that of other railroads so far as form is concerned, having a basket form over the exhaust pot. The Rock Island has a cylindrical spark arrester. (See *Railway Mechanical Engineer*, January, 1919, page 41.)

"This road has several hundred locomotives fitted with this device, with the most gratifying results."

With these variations of designs of front ends the question arises with this committee as to what should be endorsed as the best form of arrangement of a standard front end and what should be the basis of design of the stack under present day conditions. At this time the committee is unable to make recommendations.

Grates.—In studying the grates in use on large locomotives, we find that they are for the most part of the finger type, and are divided into four sections. During the past few years power shakers have been introduced on a considerable number of the larger locomotives. In such case the arrangement is such that the grates can be shaken either by power or by hand and, of course, in a very much shorter time than by the former method.

There is a tendency on the part of several railroads to change from the finger type grates to the table type. Tests recently made on one road show a decided saving in fuel due to the change from the finger to the table grates.

Ash Pans.—The general design of ash pans must necessarily be adapted to the particular class of locomotives, some locomotives permitting a different arrangement than others. In general it would appear that the ash pan is designed to fill a space that has been left over after other parts of the locomotive have been utilized to the best advantage. So far as the type of hopper is concerned, it seems that the duplex hopper type is in most general use, although there are a considerable number of multiple hopper type ash pans in service.

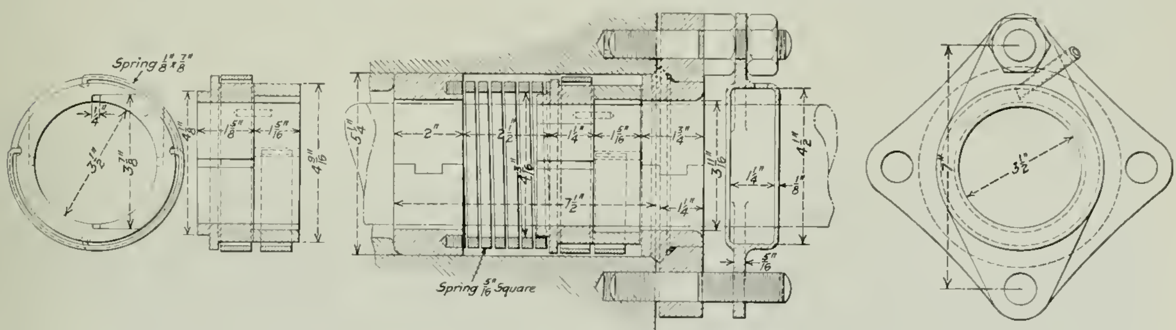
In general the ash pan doors open so as to dump the ashes towards the back end, although on a few railroads the two doors open, the one towards the front and the other towards the back of the locomotive.

In many instances the mechanical engineers are not coordinate in their actions; the designs that are satisfactory on one railroad are sometimes discontinued on another. This is particularly true with reference to the sliding versus the hinged door.

The report was signed by H. B. MacFarland (A., T. & S. F.), chairman; W. J. Bohan (N. P.), E. B. DeVilbiss (Penn. Lines), J. P. Neff (Am. Arch Co.), and Frank Zeleny (C., B. & Q.).

CAST IRON PISTON ROD PACKING

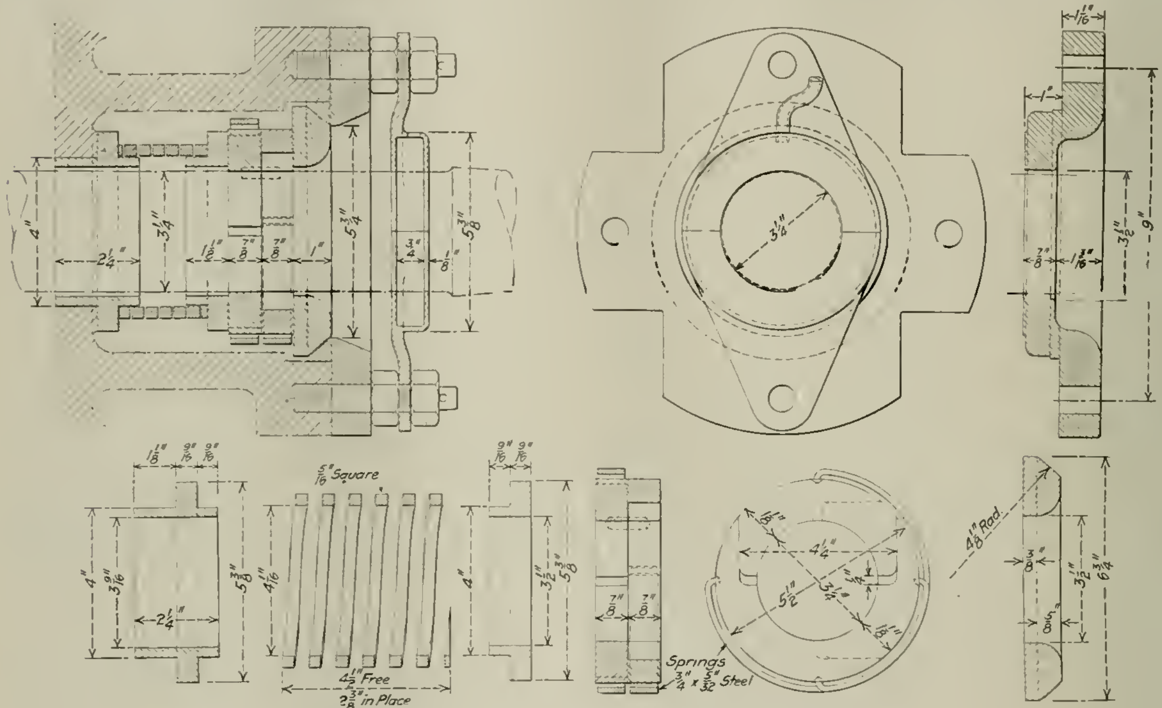
Two of the prominent railways of Great Britain, the London & North Western and the North Staffordshire, having experienced difficulty with their white metal piston rod packing on superheater locomotives have successfully developed a cast iron packing which has given particularly good service for some little time. The packing used on both these railroads is made in their local shops. The London & North Western uses a mixture of 40 per cent selected scrap, 30 per cent Kettering silicious material and 30 per cent old ingot molds (Hematite). The North Staffordshire railway makes its packing from an ordinary commercial quality of cast iron with approximately 33 per cent Barrow Hematite added.



Cast Iron Piston Rod Packing Used on the London & North Western

On both these roads the cast iron packing is used with modern locomotives, both in freight and passenger service. The North Staffordshire railway uses the cast iron packing on saturated steam locomotives as well as on the superheated steam locomotives, the design shown in one of the illustrations being used as a standard for all locomotives on that line. Reports from that railway state that a large saving in maintenance has resulted in the use of this packing, its experience having resulted that the white metal packing is many times more troublesome and expensive than the cast iron packing. For example five engines using the ordinary metal packing under saturated steam required 136 changes during 12 months, while five engines using the cast iron packing under superheated steam required no intermediate changes during the same period. Four of these locomotives had the packing taken out once for general overhauling, and one of the locomotives had the packing removed twice for overhauling during the same period. It is further stated that very little scouring of the piston rods is found with the cast iron packing, and the experience shows that the rods wear longer than they do with the white metal packing.

The design of the cast iron packing used on the London & North Western is also shown, but it should be stated that this design is somewhat restricted on account of the stuffing boxes used on the locomotives on this road. Very satisfactory results have been obtained, however, although more definite information cannot be given because a sufficient quantity of this packing has not been used long.



Cast Iron Piston Rod Packing Used On the North Staffordshire

U. S. Army Flat Cars at the American Supply Base at Glevres, France. Part of the Huge Stocks of Army Supplies Sold to the French Government for $300,000,000

Fireproof Terminal Oil House

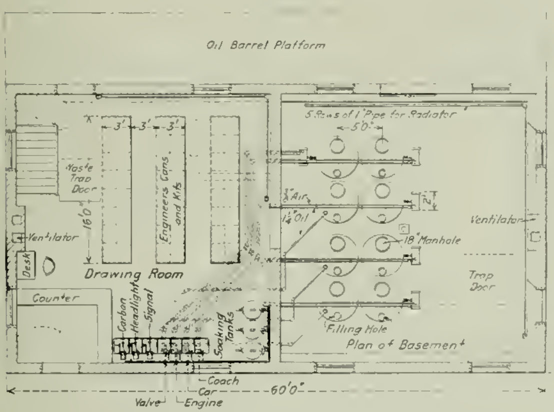
Floor Plans of Tank Arrangement and Details of Apparatus for Convenient Handling of Oil

BY ALBERT P. SHARP

The housing and handling of oils is a subject that has been given considerable study and a layout of an ideal arrangement for a railroad terminal fireproof oil house is shown in the illustrations. This house is equipped with eight tanks of 24 barrels capacity each, but can be enlarged upon or reduced without changing the method of handling the oils.

In this plan a special study has been made of safety and convenience with the greatest economy in handling oils and other materials that are usually kept at a station of this kind, such as waste, engineers' cans and kits.

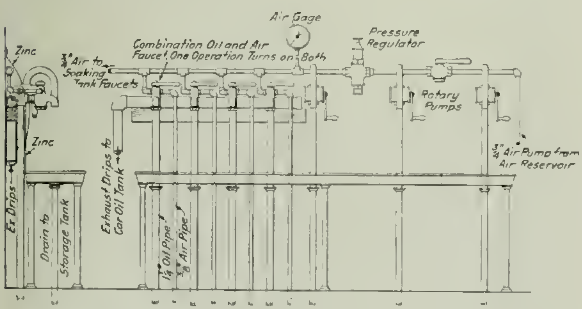
The oil is received from cars, the floors of which are on



Terminal Oil House Plan No. 1

a level with the receiving and shipping platform and is transferred from barrels to the tanks in the basement by gravity through filling pipes, provision being made for the elimination of foreign matter by having the oil pass through a suitable screen or sieve before reaching the tank. The name of the oil contained in the tank is cast on the lid of the cover of the filling box.

All lubricating oils are drawn from tanks by air pressure,



Arrangement of Combination Cocks and Other Fittings—Plan No. 1

but for illuminating oils rotary or other hand-operated pumps should be provided to avoid the serious injury to oil and the resultant accidents that might occur through the failure of a lamp caused by the moisture in the air.

Small auxiliary air tanks or receivers are provided with stop cock and check valve, the latter placed to open away from and thus insure no air reaching the main tanks.

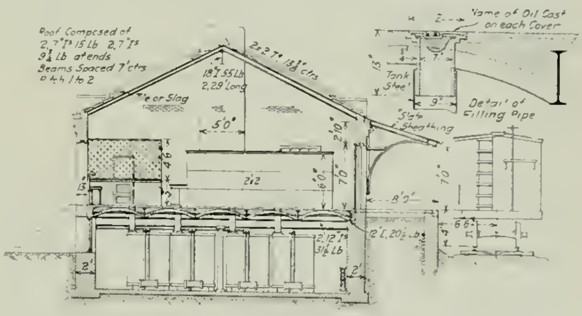
Special attention is called to the arrangement of piping, faucets and delivery counter and to the combination cock or faucet, used in drawing oils, by means of which air pressure is admitted to the auxiliary tanks only during the process of drawing and by the same movement used for drawing the oil, thus eliminating a continuous air pressure on the oil and its resultant moisture.

The convenient arrangement of faucets and delivery counter reduces the time necessary for the delivery of oil to a minimum.

The air enters a receiver placed in the basement, and provided with a connection to a sewer and a stop cock for the purpose of blowing off occasionally and removing any moisture or foreign matter that might have accumulated. It then passes from the receiver through a stop cock, thence through a pressure regulator to faucets at the delivery counter. The regulator is set to avoid splashing of the oils when drawing.

Provision is also made for soaking tanks for the preparation of journal packing, the oil being supplied to these tanks by air pressure also.

While the number of locomotives and cars to be taken care of did not enter very largely into the design of the oil house shown in plan No. 1, it was worked up for the express purpose of showing an ideal arrangement which could



Cross Section of Oil House and Filling Pipe—Plan No. 1

easily be modified to suit the requirements of an oil house under almost any conditions.

When it is possible to receive oils in tank cars, greater economy in handling will be effected by an arrangement of pipes to discharge the oil direct from the tank car to the storage tank in the basement.

A number of houses, one of which is shown in plan No. 2, using the same system and apparatus as outlined in plan No. 1, have been built and are in successful operation. This house is of a considerably larger capacity and shows the tanks lying horizontally and supported on concrete saddles, the oil being received from oil tank cars by gravity, as well as from barrels through filling boxes, if necessary.

The capacity of this house is 750 barrels of oil and provision is made to take care of waste and engineers' kits in a similar way to that shown in plan No. 1, but not repeated here. This house takes care of an assignment of 200 locomotives and a car repair yard of 240 standing room capacity.

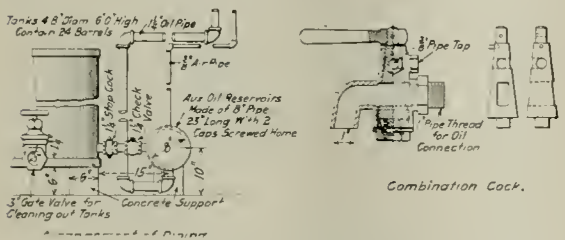
The amount of oil and the various kinds handled is as follows:

Item.	Gallons. For auto trucks	Consumption per month
No. 4 Autoline 150 Degrees	16,000	13,000 gallons
Car	4,200	3,000 gallons
No. 1 CTL	4,200	1,500 gallons
Signal	4,200	1,000 gallons
Air compressor	bbl. lots	100 gallons
Coach-Engine	4,200	2,100 gallons
Turbine	4,200	750 gallons
Transil	bbl. lots	25 gallons
Fuel	4,200	4,000 gallons
G. R. E.	bbl. lots	147 pounds

It will be noted that several kinds of oils are received in small barrel lots and are stored in the barrel, no provision being made in the way of tanks for such small quantities.

There are several details that it might be well to call to the attention of those interested.

While not shown in plan No. 1, it is understood that all

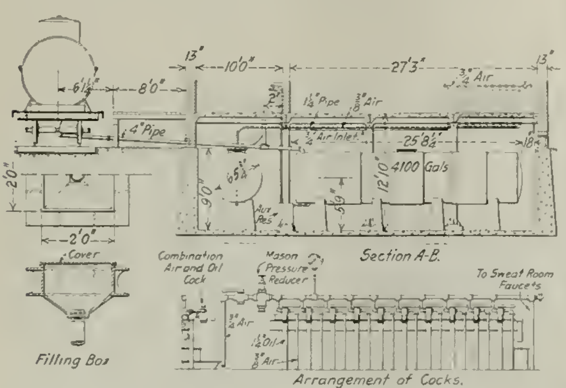


Combination Cock and Arrangement of Piping—Plan No. 1

tanks should have a vent, preferably in the manhole cover, of a 1-in. hole. Some recommend carrying the vent to the outside of the building through a 1-in. or 1¼-in. pipe. The writer thinks this an unnecessary expense, as all oil houses should be provided with ventilators in the roof or through the chimney, as shown in plan No. 1, except in cases of kerosene and gasoline, the latter at all times being stored outside of the building, preferably in a buried tank.

THE COMBINATION COCK

At each application of this combination air and oil cock there is an exhaust of more or less oil, depending on the speed used in operating the cock. This amounts to about

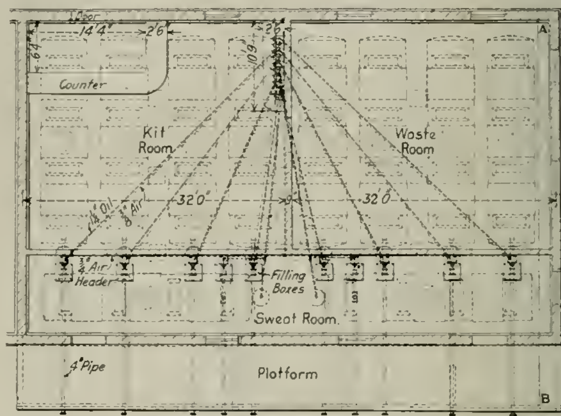


Cross Section of Oil House, Plan No. 2. Arrangement of Cocks and Filling Box

a tablespoonful of oil, the reclaiming of which is provided for by a 1½-in. drip pipe located in the rear of the battery of cocks or faucets and long enough to receive the oil from the ⅜-in. exhaust outlet on each cock. This is outlined in the arrangement of cocks, plan No. 2, which shows how the excess oil reaches the drip can.

FILLING BOXES

The filling boxes are located in the floor of the sweat room in front of and in line with the center of each large receiving tank and are used for the purpose of taking care of oil shipments in barrels, either in receiving or dispatching, the filling of barrels being done by a combination cock located immediately over each filling box. The excess, through spill-



Terminal Oil House Plan No. 2

ing over and from the combination cock, or what might otherwise be wasted oil, is taken care of by the funnel shaped filling box which allows this excess to return to the tank from which it came.

These filling boxes are set to project 1½-in. above the floor level for the purpose of excluding sweepings and other foreign matter which might otherwise find its way into the storage tanks, also to better allow the barrel to rest upon them while filling or emptying, thus preventing the oil from running over the floor and being wasted.

Photo Copyright by Underwood & Underwood, N. Y.

The Port at Stockholm, Sweden

RAILROAD ADMINISTRATION NEWS

Director General Hines took his first vacation since he became connected with the Railroad Administration, during the month of September. He was away from Washington for the two weeks ending September 20.

MECHANICAL COMMITTEE MEETING

At a meeting of the Committee on Mechanical Standards last week a special committee consisting of A. W. Gibbs, H. L. Ingersoll and John Purcell was appointed to consider the elimination of angle cocks from the air brake train line. A report and recommendation will be made to the committee at its next meeting in November. The committee also made some minor changes in the proposed standard designs for caboose cars, which, as amended, will be submitted to W. T. Tyler, director of the Division of Operation, for final approval.

COST OF FREIGHT TRAIN AND LOCOMOTIVE SERVICE

The total cost of freight train service, including locomotive service, continues to show a steady decrease each month as compared with preceding months, although increases as compared with last year, according to the monthly report of the Operating Statistics Section. For the month of June it was 101.8 cents per 1,000 gross ton miles, as compared with 103.9 in May, 112.7 in April, 119.5 in March, and 126.5 in February. No comparison of this figure with last year is given. The cost of freight locomotive service per locomotive mile in June was 107.1 cents, as compared with 97.4 cents in June, 1918, an increase of 10 per cent, and as compared with 110.3 cents in May of this year. The cost of freight train service per train mile was 154.7 cents, as compared with 142.8 cents in June, 1918, an increase of 8.3 per cent, and as compared with 156.8 cents in May. All items of cost continue to show increases as compared with last year. The combined averages for all regions and the comparative figures for last year and for preceding months of this year are as follows:

				June 1919	June 1918
Cost of locomotive service per locomotive mile				107.1	97.4
Locomotive repairs				36.1	31.1
Enginehouse expenses				8.8	6.8
Train enginemen				19.6	18.5
Locomotive fuel				39.1	38.1
Other locomotive supplies				3.5	2.9
Cost of train service per train mile				154.7	142.8
gross ton-miles	101.8	103.9	112.7	119.5	126.5
Enginehouse expenses / Locomotive repairs				51.1	43.7
Locomotive fuel				44.6	43.9
Other locomotive supplies				4.0	3.4
Train enginemen				22.3	22.3
Trainmen				25.6	25.3
Train supplies and expenses				7.1	5.2

	June, 1919	May, 1919	April, 1919	March, 1919	Feb'y, 1919
Cost of train service per 1,000 gross ton-miles	33.7	35.4	38.6	40.8	43.1
Locomotive fuel	29.3	30.6	34.3	37.5	40.3
Other locomotive supplies	2.6	2.6	2.9	3.1	3.4
Enginemen and trainmen	31.5	31.1	32.4	33.5	34.8
Train supplies and expenses	4.7	4.2	4.4	4.6	4.8

HOURS OF SHOP EMPLOYEES INCREASED TO NINE

The effect of the recent strikes of shop employees is plainly seen in the reports of bad order freight cars as of August 9, when the percentage of bad orders had increased to 9.3, although the strikes were not terminated until about a week later. On August 9 there were 144,000 cars requiring heavy repairs and 83,000 requiring light repairs. Since then the shop employees have been put on a nine hour a day basis. On August 2 the bad order cars were 8.5 per cent, as compared with 7.1 per cent on the corresponding date in 1918. About 135,000 required heavy repairs and 73,000 light repairs. A year ago the classification was not recorded. On July 26, the date of the last report preceding the strike, the percentage was 8.5 as compared with 7.2 the year before, and 139,183 required heavy repairs and 68,922 light repairs, a total of 208,105. On that date 106 roads or 77.9 per cent had more than 4 per cent of their cars in bad order and 30 roads, or 22.1 per cent, had less than 4 per cent. Forty per cent of the bad orders were box cars and 25 per cent were gondolas.

The number of bad order cars increased during the spring months while traffic was light and while the Railroad Administration was exerting great pressure to effect economies. In February the hours of the mechanical forces were reduced from the war basis to eight hours a day and in March the forces were reduced. At that time there were 400,000 to 500,000 surplus freight cars. In the latter part of June, when traffic began to pick up and a large number of cars were automatically put in the bad order class by being assigned for grain service, orders were issued to increase the car repair forces, but the strike came before much headway had been made.

SHOP CRAFTS AUTHORIZE LEADERS TO CALL STRIKE

The railroad shop employees affiliated with the American Federation of Labor have voted 325,000 to 25,000 to authorize their officers to call a strike to enforce their original demands for a general increase in wages from 68 to 85 cents an hour rather than to accept the offer recently made to them by the President and Director General Hines of increases of from 4 to 7 cents an hour by way of readjustment. The vote places full authority in the hands of the officers, however, and they apparently decided to take what they can get while waiting for a reduction in the cost of living or an opportunity to renew their demands. Although they had once rejected the offer the officers entered into conferences with Dirctor General Hines and his assistants in the Railroad Administration on September 5, prepared to accept the offer and to negotiate for the national agreement covering rules and working conditions which Mr. Hines had promised them before the negotiaitons were broken off on August 1 by the unauthorized strikes. Mr. Hines attended the conferences on Friday and Saturday and they were continued this week by his assistants after Mr. Hines had left for a vacation of about two weeks.

Director General Hines on September 4 addressed an ultimatum, similar to that issued in the case of the striking trainmen in California, regarding the local and unauthorized shop strikes on the New York Central at Depew, N. Y., on the Baltimore & Ohio at Cumberland, Md., and on the Chicago, Burlington & Quincy at Havelock, Neb., saying that unless the men returned to work not later than their regular reporting time on Saturday, September 6, they would be considered as having permanently left the service, their places would be filled and if they returned to the service later it would be only as new employees. This notice was conveyed in telegrams sent to the regional directors, stating that the chief executives of the shopmen's organizations had definitely instructed their men to return to work, directing that the federal managers post the telegrams conspicuously on bulletin boards and consider them as their instructions to proceed accordingly.

ORDERS OF REGIONAL DIRECTORS

Chicago Joint Agreement Between Brotherhoods.—Circular 88, of the Northwestern regional director, quotes rules of the Chicago Joint Agreement between the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen, which are to be incorporated into existing schedules on railroads where such schedules exist and where they are not already included.

Repairs to New Freight Car Equipment.—The Southwestern regional director, in Order 232, states that when new freight car equipment built for the Railroad Administration is placed in shop or on track shop for repairs all bolts should be gone over and nuts tightened to insure taking up all shrinkage that has taken place since the cars were built.

Automobile Cars—Safety Chains on End Doors.—Order 233 canceling Order 227 of the Southwestern regional director states that the Safety Section recommends that chains or some other suitable device be applied on automobile cars with end doors to prevent these doors opening further outward than the line of the side of the car, and suggests that all cars, regardless of ownership, be so equipped as rapidly as possible.

Accident Prevention Drives.—The Northwestern regional director, file 97-1-20, announces the National Railroad Accident Prevention Drive, from October 18 to 31, inclusive, and suggests that federal managers call a meeting of general officers to discuss plans for making this drive a success, the meeting preferably to be held in conjunction with the meeting of the General Safety Committee if the meeting of that committee is scheduled to be held in advance of October 1.

Fire Prevention—Smoking.—Supplement 11 to Circular 32 of the Northwestern regional director states that during 1918 there were reported to the Fire Loss and Property Protection section, 252 fires directly attributable to carelessness in smoking or the use of matches, with a total loss of $159,629, and calls attention to the necessity for strict enforcement of the no smoking rule in wood working shops, paint shops, etc.

DIRT IN COAL*

BY L. J. JOFFRAY
General Fuel Inspector, Illinois Central

The ash content in coal varies widely in different localities and frequently there is considerable variation in the same locality under different conditions of mining and preparation. The normal amount of ash may be considered as that found in the face sample of the seam proper; the excess ash is that which is added to the coal from the roof or bottom in the process of mining and which is not eliminated before the coal leaves the mine.

Lump coal made over a 1¼-in. screen usually shows the normal per cent of ash, while the 1¼-in. screenings in most cases show one and one-half times the percentage of ash contained in the lump.

The ash content in screenings can be reduced nearly to that of the screened lump by the use of a jig gravity washer, with an ample water supply and a convenient place to deposit the refuse. However, the washing of screenings has been considered too expensive while the price of all coal was low, but since prices have gone 60 per cent and more higher, and will probably remain so, it may be well, and at the same time profitable, to eliminate the excess ash by washing in the vicinity of the mines, thereby saving the use of cars for and the long haul on inert material to points where coal is finally consumed, the cost of which would be about six mills per ton-mile.

The following table showing ash and B. t. u. content of coal from a bituminous mine in the central west district illustrates how the ash content of screenings can be reduced by washing:

	Ash, per cent	B. t. u.
Dry or unwashed screenings	22.61	8,895
Washed screenings	14.05	10,085
Lump	12.39	10,499

The excess ash in mine run and prepared sizes, made over an inch and a quarter screen, can easily be removed by hand by the miner at the working face when loading into mine cars, or by having men or boys working on picking tables or belts while the coal is passing to the railroad car.

The performance of this work can be looked after by a regularly assigned fuel inspector. We are using a system of close inspection with suggestions to the mine superintendents on the ground while the coal is being loaded. As a result of this effort, the impurities removable by hand picking and based on actual carload tests have been reduced from an average of 2.733 per cent in the year 1911 to an average of 1.535 per cent in the year 1917, or a net reduction of 1.198 per cent which applied to a consumption of 4,000,000 tons of coal used annually represents 47,920 tons less ash, requiring the use of 958 fifty-ton cars to move same. The transportation cost of moving this excess ash an average distance of 266 miles, based on an "out of pocket" cost of five miles per net ton-mile, equals $63,733.60 per annum. This, however, is but the lesser saving.

Taking the established estimate of increase in efficiency of 1½ per cent for each reduction of one per cent in ash, the saving from this source, i. e., increased evaporative efficiency, with coal at a delivered price of $3.68 per ton equals $264,518.40, or a total saving of $328,252.00 per annum. What the measure of the economies following from reduced engine failures and reduction in enginehouse expense amount to are difficult of computation.

ELEMENTS OF ASH

The effective combustion of coal depends largely on the nature and per cent of impurities it contains, especially so if the ash has a tendency to clinker, which is dependent on the percentage of silica, iron and lime in its composition. Tables I and II give analyses of coal and ash, respectively, used in ten burning tests from ten different mines in Illinois and Indiana.

TABLE I—ANALYSES OF COALS

Test Number	Moisture per cent	Volatile matter per cent	Fixed carbon per cent	Ash per cent	Sulphur per cent	B. t. u.	Clinker?
1	3.37	31.31	55.19	9.63	.64	12,325	No
2	6.02	30.00	53.50	10.30	1.30	12,136	No
3	4.61	31.35	54.05	10.00	1.19	12,368	No
4	2.92	33.10	51.25	12.73	2.96	12,389	Yes
5	4.99	39.22	43.99	11.80	4.43	11,768	Slightly
6	3.41	37.12	45.62	13.85	4.02	11,842	Yes
7	5.13	37.70	44.31	12.80	4.52	11,693	Yes
8	2.86	36.04	43.14	17.96	4.58	11,124	Yes
9	8.49	34.87	48.16	8.48	1.47	12,251	No
10	4.68	38.59	44.24	12.49	4.50	11,921	Yes

TABLE II—ANALYSES OF ASH

Test Number	Sulphur (S) per cent	Silica Oxide (SiO_2) per cent	Iron Oxide (Fe_2O_3) per cent	Aluminum Oxide (Al_2O_3) per cent	Calcium Oxide (Lime) (CaO) per cent	Magnesium Oxide (MgO) per cent	Color of ash
1	.64	59.0	3.1	31.0	5.6	1.3	White
2	1.30	55.2	8.3	26.6	7.3	1.3	White
3	1.19	56.1	8.1	27.2	5.4	.9	Light gray
4	2.96	45.4	25.3	16.9	11.6	.8	Reddish gray
5	4.43	49.1	32.2	13.5	4.5	1.4	Reddish gray
6	4.02	35.1	22.4	10.2	30.8	1.5	Reddish gray
7	4.52	43.3	24.1	9.0	19.9	1.2	Reddish gray
8	4.58	44.8	20.3	18.6	16.4	1.5	Reddish gray
9	1.47	45.8	20.2	28.3	5.4	0.0	White
10	4.50	27.1	52.3	14.1	4.4	1.2	Dark gray
Fusing tem. deg. F.	239	3227	2840	3416	3452	3882	....

Table I gives the usual proximate analyses of the coals. Table II gives analyses of the ash. By referring to the column showing the clinkering and non-clinkering coals and then making a review of the ash table, we observe that the coals with non-clinkering ash are low in both sulphur and lime. In burning they did not clinker in a dazzling white fire of an approximate temperature of 2,900 degrees F., while the ash in the clinkering coals fused at a fire-box temperature of approximately 2,200 degrees F., which indicates clearly that when the sulphur and lime content exist in high proportion to the silica, iron and aluminium oxides, it is the direct cause of the ash fusing at the lower temperature.

*Abstract of a paper presented before the convention of the International Fuel Association at Chicago, May 19-22, 1919.

The bottom line of Table II shows the fusing point of the sulphur and the different oxides. From this it will be seen that by taking each element separately the fusing point is at a higher temperature than is usually obtained in the furnace of a boiler. However, by combining these elements in proper proportion with the sulphur, fusion at a much lower temperature will take place.

The conditions of these ten experiments as to draught, etc., was identical in each case. However, I have since observed that either one of the coals containing the clinkering ash will give better results both as to combustion and reduction of slag in the ash by increasing the draught, which increases the flow of air through the fire bed and has a tendency to keep the temperature of the fire below the fusing point of the ash. Hence it is always good policy to assign the clinkering coals to a lower class of service, as switch engine, local freight, and other light runs. However, when considering the possibility of burning the low grade clinkering coals to profitable advantage, such should not be construed so as to minimize the responsibility of those who are assigned the duty of eliminating all impurities possible when the coal is being prepared at the mines.

SANTA FE TYPE LOCOMOTIVES FOR LIGHT TRACK

A group of three Santa Fe type locomotives has recently been completed by the Baldwin Locomotive Works for the Alabama & Vicksburg. These locomotives are to be used for heavy freight service and are designed to operate on rails weighing 75 lb. per yard and over. They are of special interest as they illustrate the suitability of the Santa Fe type for heavy freight service on lines where the track conditions will not permit the use of motive power having high wheel loads.

As far as practicable, the detail parts of the Santa Fe type locomotives are designed to interchange with those of the Pacific and the Mikado type locomotives previously built for the same road.

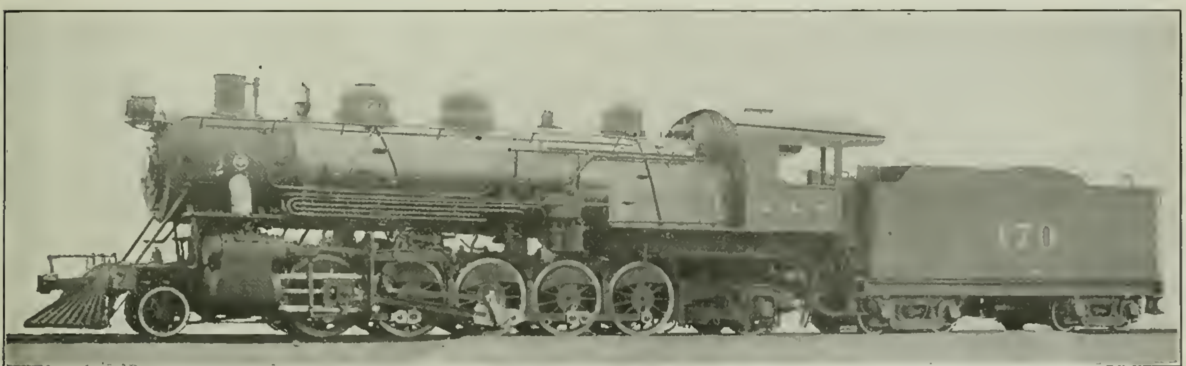
The following table of dimensions will give the comparison between these locomotives and the Mikado type.

	Santa Fe type	Mikado type
Cylinder dimensions	26 in. by 28 in.	22 in. by 28 in.
Drivers, diameter	57 in.	57 in.
Steam pressure	185 lb.	200 lb.
Grate area	58.7 sq. ft.	46 sq. ft.
Water heating surface	3,278 sq. ft.	2,573 sq. ft.
Superheating surface	754 sq. ft.	561 sq. ft.
Weight on drivers	218,390 lb.	168,400 lb.
Weight, total engine	274,715 lb.	217,500 lb.
Tractive effort	52,300 lb.	40,400 lb.

The boiler is a straight top design with a fire tube superheater. A Gaines combustion chamber is applied in connection with a Security firebrick arch, which is supported on four three-inch tubes. The front end of the firebox crown is suspended on three rows of Baldwin expansion stays. The main frames are of annealed vanadium cast steel. The bolster of the front truck is suspended on heart shaped links. The rear truck is of the Delta type and is used in combination with the Commonwealth rear frame cradle.

The Walschaert valve motion is applied and is controlled by a type *B* Ragonnet power reverse gear. The piston heads are of steel and the packing rings are made of gun iron. The latter material is also used for the steam chest bushings and the valve packing rings.

The main driving axles and the rear truck axle are of chrome vanadium steel quenched and tempered in accordance with A. S. T. M. specifications. All wearing brasses, including the crosshead gibs and driving wheel hub liners, are of phosphor bronze. The pedestal wedges and gibs are of brass. The firebox is equipped with a power operated firedoor.



Alabama & Vicksburg 2-10-2 Type for Heavy Freight Service

General Data

Gage	4 ft. 8½ in.
Service	Heavy Freight
Fuel	Soft coal
Tractive effort	52,300 lb.
Weight in working order	274,715 lb.
Weight on drivers	218,390 lb.
Weight on leading truck	26,325 lb.
Weight on trailing truck	30,000 lb.
Weight of engine and tender in working order	440,700 lb.
Wheel base, driving	20 ft. 4 in.
Wheel base, total	37 ft. 2 in.
Wheel base, engine and tender	71 ft. 3¼ in.

Ratios

Weight on drivers ÷ tractive effort	4.2
Total weight ÷ tractive effort	5.2
Tractive effort × diam. drivers ÷ equivalent heating surface*	691.2
Equivalent heating surface* ÷ grate area	73.4
Firebox heating surface ÷ equivalent heating surface,* per cent	6.0
Weight on drivers ÷ equivalent heating surface*	50.7
Total weight ÷ equivalent heating surface*	63.8
Volume both cylinders	18.5 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	232.4
Grate area ÷ vol. cylinders	3.2

Cylinders

Kind	Simple
Diameter and stroke	26 in. by 28 in.

Valves

Kind	Piston
Diameter	14 in.

Wheels

Driving, diameter over tires	57 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 in. by 12 in.
Driving journals, others, diameter and length	10 in. by 12 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6 in. by 10 in.
Trailing truck wheels, diameter	40 in.
Trailing truck, journals	7½ in. by 12 in.

Boiler

Style	Straight
Working pressure	185 lb. per sq. in.
Outside diameter of first ring	75¼ in.
Firebox, length and width	148 1/16 in. by 78⅛ in.
Firebox plates, thickness	Sides and back 5/16, crown ⅜, tube ½ in.
Firebox, water space	Front 5 in., sides and back, 4 in.
Tubes, number and outside diameter	32—2 in.
Flues, number and outside diameter	215—5⅜ in.
Tubes and flues, length	19 ft. 3 in.

Heating surface, tubes and flues	3021 sq. ft.
Heating surface, firebox, including arch tubes	257 sq. ft.
Heating surface, total	3,278 sq. ft.
Superheater heating surface	754 sq. ft.
Equivalent heating surface*	4,309 sq. ft.
Grate area	58.7 sq. ft.
Tender	
Tank	Water bottom
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

CERTAIN ESSENTIALS*

By EUGENE McAULIFFE
Manager, Fuel Conservation Section, United States Railroad Administration

I wish to today to say a few words on certain compelling features which, if attended to, will accomplish more in one year towards effecting fuel and operating economies than has been accomplished in the past five years. Briefly, the outstanding essentials of the railway fuel problem are:

Clean Coal.—Buy clean coal, get clean coal. There is not a coal contract in existence that does not suppose the delivery of the cleanest coal that the particular mine from which the purchase is made is capable of producing. Do not ask from the coal producer the impossible, but insist on the possible Tests have proved that with coal containing 12.5 per cent of ash taken as 100 per cent the relative efficiency falls as the ash increases until coal with 40 per cent of ash marks a total lack of efficiency. At the mine face, or on the mine tipple, is the place to clean coal. The excess and removable non-combustible matter can be separated cheaper there than in the locomotive firebox. Let the producer do the cleaning, such is a proper part of the cost of production. I have found on a majority of roads an insufficient and frequently untrained inspection force. The roads which most need an inspection force are most lacking in this respect. Ninety-nine per cent of the coal operators, all that are worth considering, will appreciate the help that an intelligent inspection force can give them. Good inspection supposes many things, including contract, quality, weights, clean equipment and proper class of equipment.

Distorted Valve Motion.—The next cheapest thing we can do is to organize the work of establishing and maintaining a proper distribution of the steam made from the coal purchased. I commend to your attention the paper written by J. W. Hardy on fuel losses due to defective valve motion, then read the circular just issued and immediately proceed to carry out the simple recommendations therein contained.

Air Leaks in Locomotive Front Ends.—On August 1, 1918, the Fuel Conservation Section issued Circular No. 8 calling the attention of motive power men to the fuel losses that result from air leaks in locomotive front ends, particularly those that surround the steam pipes where they leave the front end. The recommendations contained in this circular were followed in some instances; in others, ignored. A locomotive suffering from front end leaks invariably fails unless her guardians have compromised with her cost of keep and earning power by choking the nozzle.

Distorted Draft Apparatus.—A limited survey of the interior of locomotive front ends can be easily made by looking down into the stack when the engine is cool, using a common flash light. This casual inspection, if made, will astonish many of you. Here, again, we lack organization and method. Distorted draft apparatus invariably indicates shiftlessness.

Stopped Up Flues, Grates and Ash Pans.—Another essential has been covered briefly by the recent Fuel Conservation Section circular dealing with stopped up flues and choked superheater unit tubes, choked air openings in grates, and restricted air inlets in ash pans. An insufficient air opening in the ash pan represents a defect in design; the rest represents defects in execution. These conditions again result in the application of the well-known remedy, choking the exhaust nozzle, with the result that the engine struggles part or all the way over the division at the expense of the fuel bill, delaying the reduced tonnage handled, with corresponding delays to opposing trains which are side-tracked at meeting points to wait for the crippled engine.

The Superheater.—Another essential I wish to speak of relates to the proper maintenance and handling of what is the most substantial fuel saver ever put on the American locomotive, i. e., the superheater. The purpose of the superheater is to conserve fuel and water, and to increase the general efficiency of the locomotive. In some instances this result is obtained to the extent of 100 per cent, the measure of efficiency shading off in other cases until the apparatus is frequently not able to absorb the load of improper locomotive maintenance put on its shoulders. Certain engineers carry water levels so high as to transform the superheater into an evaporator, getting the train over the road at the expense of much fuel and a few additional tanks of water. We have found superheater units not only improperly installed, but poorly maintained, and often they are not tested with sufficient frequency to locate the steam leaks that occur in the front end when the engine is working. The Fuel Conservation Section recently issued a circular on superheater losses; they deserve your best attention.

Back Pressure Losses.—A condenser cannot be used on a locomotive, and the limitations that surround the locomotive necessitate a restricted exhaust in order that a sufficient rate of combustion can be maintained with a relatively small boiler, generating many hundreds of horsepower. Under the conditions that commonly obtain, of all the fuel that is used in the locomotive, only about six per cent is available for use in moving freight or passengers. Excess back pressure losses, therefore, apply against the six per cent saved for tractive purposes. Under the circumstances, why cripple the locomotive by choking the exhaust to offset lack of proper adjustment of draft apparatus, the closing of air leaks in front ends, the cleaning of tubes, superheater flues, etc.?

The Old Type of Locomotive.—Many of us began with the eight-wheel type of locomotive with low steam pressure and small firebox and grate area. These little engines had no fuel-saving devices, but they played their part in the greatest peaceful drama the world ever saw, the building of the Western Empire. Too many light locomotives have been scrapped in the past; instead they should have been modernized and kept in service suited to their capacity. In many instances locomotives too heavy for the job are employed to the detriment of train-mile costs and the permanent way. The fuel-saving attachments developed in recent years, with the exception of the compound air pump, only earn when the locomotive is moving, and it is very probable that improvements of the above character, if applied to the existing light locomotives now lacking them, would pay an equal or greater return than is being received from their application to the more modern locomotives. We frequently overlook the fact that the heavier types of locomotives, of which these devices are considered an essential part, make a lower average mileage than the lighter and, consequently, a more mobile type.

In conclusion, I wish to suggest the absolute importance of bringing every locomotive now in service, or that will be required for the service, up to the maximum standard of efficiency. I have been told that the work of applying superheaters and brick arches under order, and in some cases in stock has been held up on certain roads because of insufficient funds to apply them. This is unfortunate, and I trust the condition will be quickly remedied.

*Abstract of a paper presented at the convention of the International Railway Fuel Association at Chicago, May 19-22, 1919.

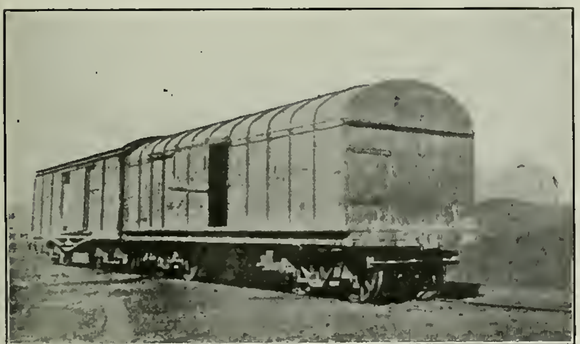
CAR DEPARTMENT

GENERAL CHARACTERISTICS OF CHINESE ROLLING STOCK*

One of the great needs of the Chinese government railways at present is a very considerable increase in freight cars and locomotives. The rolling stock per mile of line of 2,774 miles of Chinese railways, compares with several other countries as follows:

	Chinese Railways	Japan (1916)	Germany (1913)	U. S. (1916)
Number locomotives per mile	.18	.47	.77	.26
Number passenger cars per mile	.38	1.19	2.29	.45
Number of freight cars per mile	3.23	7.42	17.60	9.85

The initial equipment on all the lines (particularly those first constructed) is representative of the practices of the nations furnishing the loan funds. As a result, the Chinese railways today have, as a whole, a more miscellaneous assortment of equipment than any other equal mileage of railways in the world. A considerable part of the rolling stock (particularly the locomotives and goods wagons first acquired) is light and of small carrying capacity. This was very unfortunate, for the reason that the railway business of China is not naturally a classified-goods business but rather the transportation of commodities, and this tendency, as the railways are extended and the traffic grows, will probably become more pronounced. Therefore, the advantage of freight cars of large capacity and heavy motive power, along the lines of American practice, is readily apparent. The character of the early rolling stock forms the explanation for the light design of the bridges, which will have to be corrected at much expense before the type of equipment demanded by this class of traffic can be used. The average tractive effort of all locomotives on the Chinese government railways is now approximately 21,000 lb., the average carrying capacity of all passenger cars is 67.5 persons per car, and the average carrying capacity of all freight cars is 50,350 lb. In connection with the locomotives, however, it should be mentioned that on the Peking-Suiyuan line, which is equipped with 60 American locomotives out of a total of 66, the average tractive effort of all locomotives is about 30,000 lb., which has the effect of reducing the average of all locomotives on the other lines to about 18,700 lb.

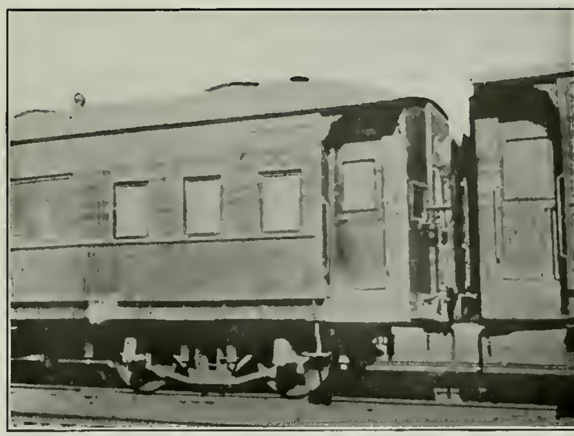


Box Car of Steel Construction Used on the Chinese Government Railways

It is also surprising to find the small amount of freight equipment that is equipped with air brakes. In one instance this lack of power brakes is limiting the coal traffic that one of the roads can handle during the winter when it should be handling the maximum tonnage. The Peking-Suiyuan line, on account of the heavy grades over the West Hills, is well equipped with air brakes on all its equipment, and the lack of brakes on the other lines is an additional restriction on the free interchange of traffic between this line and the other lines not so equipped. The Janney-Penn couple is used very generally on all the lines, and probably its use is more nearly universal than that of any other one device on the Chinese government railways.

TRAIN BRAKES

When used, air brakes are usually of the Westinghouse design of the nation furnishing the equipment. It is not usual for other nations to put as much braking on the locomotive and tenders as is the American practice. The passenger equipment, as a rule, is well equipped with air brakes, but no air train signals are in use on any of the lines. The freight equipment is only partly equipped with air brakes. Most of the lines depend on hand brakes. As a rule, every fifth or sixth car is equipped with a small shelter; the train is arranged for two of these to come together and the braking is done by hand.



Dining Car on the Peking-Mukden Railway, Showing Vestibule Without Steps

PASSENGER EQUIPMENT

Sleepers and first-class passenger cars are usually of the compartment-corridor type. The Peking-Mukden, Tientsin-Pukow, Peking-Hankow, and Shanghai-Nanking

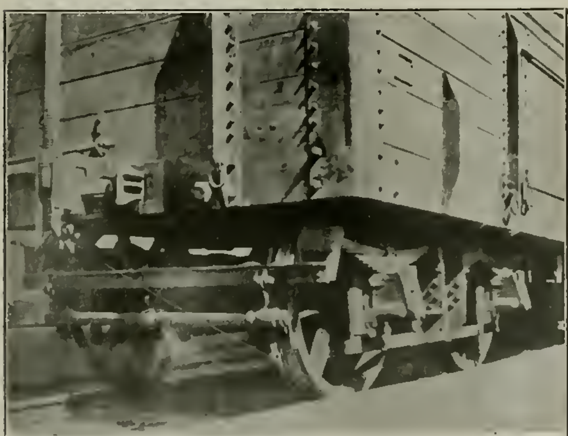
*From Special Agents Series, Report No. 80, Bureau of Foreign and Domestic Commerce, Department of Commerce, by Frank Rhea.

own and operate their own sleeping cars, and on all these lines the same equipment performs the service of first-class passenger car and sleeping car. These are the only lines running sleeping cars, and they, as well as the Peking-Suiyuan, own and operate their own dining cars.

The second-class equipment is usually provided with serviceable wooden seats and the third-class sometimes with cheaper seats, but frequently with benches; in some instances, particularly when the coolie class is carried, no seats of any kind are provided. One of the illustrations shows the vestibules and one end of a diner on the Peking-Mukden Railway. It will be noticed that there are no steps to the vestibule platforms. This requires all station platforms to be built with only a low step from the vestibule. In no instance noted by the writer was any passenger equipment heated from the locomotive, the only hose connection being the one for air brakes.

FREIGHT CARS

The initial equipment on the first Chinese railways (except that purchased from America) was of small capacity, and much of it can best be termed goods wagons, but the tendency has steadily been toward equipment of greater capacity until today practically all new freight cars are 67,200 lb., or 30 long tons capacity. All the Chinese railways use the British practice of a loading gauge. The size of equipment is somewhat restricted, and it would appear very desirable to increase this in the case of new railway construction, to permit of the utilization of larger equipment as the traffic develops, particularly if this development should be along commodity lines.



Type of Freight Car Truck Used on the Peking-Hankow Railway; Note the Vertical Plane Coupler on the End of the Car

A freight-car truck in general use on the Peking-Hankow line is shown in one of the illustrations and another shows a typical box car used on most of the Chinese railways. It was stated that this type of construction is quite satisfactory on all the lines north of the Yangtze River, but that the deterioration of the sheet iron on the southern lines, such as the Shanghai-Nanking, is quite serious. With the scarcity of lumber in China, however, this design would seem to have much merit.

CAR WHEELS

The British have used their typical steel-tired wheel, usually with cast-steel centers and of 42 in. diameter, on passenger and freight cars of all classes and capacities. The Germans have done the same with a wheel 100 cm. (39.37) in. in diameter. On the American equipment, particularly freight cars, most of the wheels have been of the regular chilled cast-iron type and, according to the information obtainable, have given satisfactory results. One of the suggestions that the writer heard mentioned a number of times was the desirability of the Chinese government railways adopting such a standard size of car wheel as can be satisfactorily produced with a chilled cast-iron wheel and then making their own supply of wheels. This seems practicable, taking into account the supply of iron ore and fuel, together with the fact that many of the Chinese shop laborers make good foundry molders.

SERVICE CARS

On account of the large amount of cheap labor in all parts of China, very little attention has been given to labor-saving service cars, and the present equipment is almost entirely confined to that which involves the use of hand labor for all classes of work. One of the most generally seen pieces of special equipment is the small derrick car, sometimes taking the form of a small locomotive crane. Steam shovels and steam wrecking cars are practically never seen.

VACUUM BRAKES

In an article by A. Fuhr published in the Annalen für Gewerbe und Bauwesen, and abstracted in the Technical Supplement of the Review of the Foreign Press, a discussion of the Clayton-Hardy vacuum brake vs. the automatic or pressure brake brings out some interesting features. It may be said that the railways in Europe are giving a great deal of consideration to the adoption of some good type of continuous brakes to their freight trains, in order that they may be handled more expeditiously.

A. Fuhr, in commenting on the vacuum brakes, states that one of the inherent difficulties of this brake is that of the low working pressure which does not generally amount to more than 14 in. of mercury, while pressure brakes operates with pressure six to ten times greater. The low pressure of the vacuum brake requires heavy and bulky machinery where the system is used. For instance, one pressure brake with a 12-in. diameter cylinder and an air receiver of 2 cu. ft. capacity, was found to produce the same effect as two vacuum brakes each with a 21-in. cylinder and an air receiver of 19 cu. ft. capacity. Modern steel cars weighing 30 to 35 tons when empty require three to four such vacuum brakes. For instance the mechanism on a car with four axles fitted with Westinghouse pressure brake weighs 116 lb. including the transmission rod and return spring, while on a car with two vacuum brakes, with 21 in. diameter cylinders, levers, plummer blocks, supports, and other working parts it weighs half a ton, or 1,120 lb. The greater weight, therefore, means more expense.

Another disadvantage of the vacuum system is that leakage in the pipe system causes a constant inflow of air charged with dust, soot, oil, moisture, etc. This occurs regularly when the locomotive is changed, and the valves and fittings therefore become choked and work badly, while the pressure brake remains clean much longer, as any grit or moisture which may be drawn in through the air-compressor is deposited in the main-air receiver and does not reach the brake valves. The number of hose pipes required with the vacuum brake is greater than that required for the pressure brake, as each passenger car fitted with reversing vacuum brakes requires five separate pipes, which must all be reinforced against collapse, while the pressure brake only needs one.

The low pressure is disadvantageous, as it is all but impossible to keep the large bore pipes and fittings tight. They are considered satisfactory according to Austrian regulations when the fall of pressure does not exceed 2½ in. of mercury per minute. The standard vacuum of 14 in. of mercury is thus reduced to 7 in. in 2½ minutes; that is to say, the vacuum brake is very sensitive to the slightest extra leakage, while the pressure brake is still quite effective if the air pressure from some exceptional reason should sink to half the standard pressure.

Expansion of air in the vacuum brake also produces a low temperature, and there is consequently a tendency to freeze up and likelihood of disturbance to traffic, especially in northern latitudes. During the severe winter 1916-1917 this tendency became almost a calamity in Sweden, as there were almost daily delays of 8 to 10 hours in the Lulea-Stockholm train service, exclusively due to the vacuum brake. It was found necessary on the iron ore line Lulea, Riksgrandsen-Narvic to remove the vacuum brakes and refit with pressure brakes.

A. Fuhr further states that the alleged greater simplicity of the vacuum brake has not been borne out in practice, owing to the cocks at the couplings, which are necessary for vacuum brakes, being troublesome, repairs difficult, readjustments frequent, and that the distance in which a train can be stopped is approximately the same as with a pressure brake.

According to tests carried out on the Prussian lines, the steam consumption of the vacuum brake is very considerable, and at least twice as high as that for similar trains fitted with pressure brakes.

Illumination of the Railway Car*

Improved Methods of Regulating Electric Lighting Equipment; New Developments Keep Down Costs

BY E. WANAMAKER
Electrical Engineer, Chicago, Rock Island & Pacific

A RESUME of the history of railway train lighting compiled from the records available shows that great strides have been made in the art since the days of the first experiments. To one Thomas Dixon, driver of the coach "Experiment" on the Stockton and Darlington Railway, in England, in 1825, is given credit for having first used artificial light in a railway car. He was a man of generous motives, and having in mind the comfort and convenience of his passengers on dark winter nights he placed a penny candle on a table, also provided by him, in the center of the car. From this humble beginning railway train lighting has grown and kept pace with the development of illumination in other fields and with the growth of other transportation facilities. Today, electric systems for lighting cars cost hundreds of dollars per car and a large number of employees are necessary to provide and maintain this service.

A review of the progress made in developing car lighting shows it is divided into periods of approximately 25 years for each illuminant used. The period of candle light lasted from 1825 to 1850, when oil lights were introduced. Oil lighting in turn gave away to gas in 1875, and gas continued to be the most generally used illuminant until about 1900, when the application of electricity to car lighting began to receive wide attention by railroads, and in this country at least is now the system generally preferred for new equipment.

Straight Storage

The earliest electric system of which we have a record was a straight storage system used on the London, Brighton and South Coast railway in 1881. Primary batteries were also tried in France in 1885 on cars operating between Paris and Brussels. At about this same time straight storage lighting was tried by the Pennsylvania Railroad and the Boston & Albany in the United States, and on the first-mentioned road this was for many years the electric system most used. Such a system requires an expensive charging plant at each terminal. Its main disadvantage is the limited time which a car can be kept in service without being held for charging and the liability of light failure due to batteries becoming discharged when trains are delayed or held from regular charging terminals. Another disadvantage arises from the fact that cars equipped with this system cannot be operated on branch lines or at isolated points where charging facilities are not available.

The "Head-End" System

"Head-end" equipment was first tried in 1887, when it was installed by the Pullman Palace Car Company in one of its composite cars operating between Jersey City, N. J., and St. Augustine, Fla., in the Atlantic Coast Line Special. In the same year, the Pennsylvania Limited was similarly equipped, and in 1888 the Chicago, Milwaukee & St. Paul also had a train equipped in this manner.

The head-end system was first tried out with a generator in the baggage car and no batteries, but due to frequent light failures caused by the trains being parted and the locomotives being cut off at division points, it was found necessary to place batteries on the first and last cars of each train so that if a train was parted to cut out or cut in cars, each section would have light. In some cases batteries were applied to each car. This greatly increased the time that lights could be depended upon in case of the generator unit being out of service and also made it possible for each car to have light when cut out.

Various means are used to control the lamp voltage and battery charging rates. Each road seems to have developed a system to meet conditions as they exist on its particular lines, which has resulted in several different schemes of wiring, battery charging and operation, all of which give results more or less satisfactory.

An axle-driven head-end system has been designed to furnish power for lighting the train and charging the batteries from a single unit, the batteries being distributed throughout the train, as for instance, one set in the baggage car, one in the observation or dining car, and sometimes one in the middle of the train. The number of batteries used and their location are governed by local conditions.

While this system is not liable to light failures, due to lack of steam, it has the same disadvantages as the steam driven, head-end systems, namely, that cars not equipped with batteries are dark when cut out of a train, that they are not interchangeable when operating on foreign lines, and are liable to light failure due to small battery capacity when trains are delayed or tied up. It would, therefore, seem that this system is unsatisfactory for universal operation.

For suburban and branch line service, the straight head-end system without any auxiliary battery has been found

*Abstract of a paper presented at the opening meeting of the Western Railway Club, Chicago, on September 15.

very economical and successful. The present practice for this class of service is to mount the turbo-generator on the locomotive in a manner similar to that used for mounting headlight turbines, the generator being of sufficient capacity to furnish current for the headlight and cab lamps and the maximum number of cars usually assigned to this class of service.

A three-wire system of wiring and standard train line connectors are used for making connections between cars and locomotive. No doubt, in the near future this system will be used more extensively on branch lines due to the low first cost, low maintenance cost, and the ease with which the installation can be made to existing power and rolling stock. All cars are similarly wired, and the number of cars in a train is only limited to the capacity of the turbo-generator and train line wires. Low first cost results from the simplicity of the car wiring system, which includes only a train line circuit and one lamp circuit connected to it with a fused knife switch in a steel switch box.

Credit for the earliest attempt at lighting a train with axle-driven equipment is given to the London Brighton and South Coast Railway, on which a crude system was tried out in 1883. Since that date development has gone on unceasingly, and individual axle-driven systems are now most generally used for train illumination in this country.

After years of test only one form of transmission for driving the generator is in general use. Various forms of belts and direct drive have been used, but due to the variable relation between the axle pulley and the armature pulley, and the climatic conditions, the rubber belt up to the present has been found to meet the requirements most economically.

Some of the first generators were suspended from the car body, others were mounted on the truck. Much time has been spent in improving generator suspensions, which has resulted in the elimination of many wearing parts, thus simplifying and reducing the maintenance costs.

The body hung suspension is favorable to the maintenance of the generator and possibly to the car truck. With it the belt is considerably longer than with the truck type suspension. Therefore, the belt life must be increased in the same proportion as the length is increased in order to keep the belt cost per car mile the same. Much is claimed for both types of suspensions, each having its possibilities, the conditions under which they operate and the condition in which they are maintained being important factors.

An important point in connection with axle lighting is the proper application of axle pulleys. If they are not properly applied the belt life will be short and the maintenance cost high. In a great many cases axle pulleys are applied to eccentric axles which should have been turned to insure a perfect pulley seat. In some cases pulleys are applied with improper pulley bushings. Eccentric pulleys and small belt clearances over the brake beam comprise two of the main causes of short belt life. Far-sighted mechanical men on some roads have made provisions for successful and economical operation of the belt drive by using turned axles or by turning a pulley seat on hammered axles to insure concentric pulleys. Also in some cases special brake rigging is being used to give ample belt clearance.

MAINTENANCE

To secure good service from the entire equipment at a low operating cost a standardized systematic method of maintenance must be used. With the present design of equipments the belt cost constitutes the second largest single item of expense. Records should be kept from which individual belt mileage can be computed. From these records any car using an excessive number of belts will be noted and steps taken to correct any defects found.

At the periodical shopping of cars the electrical equipment should be thoroughly overhauled and placed in a first-class condition, all worn parts being removed and defects corrected. If this is done thoroughly heavy repairs will seldom be found necessary between the shopping periods.

A systematic inspection of the generator and suspension should be made each trip to see that all parts are in good condition. Once each year the generator should be dismantled and all parts thoroughly cleaned, fields and armature painted with insulating varnish and new grease applied to ball bearings.

TRAIN-LINE FACILITIES AND FIXTURES

On the majority of railroads, facilities are provided for making connections from car to car so as to provide light in a defective one. It is the almost unanimous opinion of car-lighting engineers that with the present equipment, facilities for train-line connections are essential if light failures are to be avoided, connectors being especially desirable for the protection of mail cars.

The tendency in fixtures is toward simplicity of design to harmonize with the interior construction of the car. Center-deck lighting seems to be generally preferred with a sufficient number of units, properly shaded, to give uniform distribution. Enamel finishes the same color as the car walls or ceiling at the point where the fixtures are located are most used, but there is reason for believing that in time the roads will again prefer metal finishes, as these, when properly applied to fixtures of pleasing design, help to improve the interior appearance of the car. In recent years statuary bronze has been the metal finish most used.

A matter of great importance is that of careful selection and design upon which depends effectiveness of the installation, both as regards light distribution and appearance. These various questions involve a study of intrinsic brilliancy, intensity, distribution and color.

BATTERIES

There are two distinct types of storage battery in use in car lighting service at the present time, the lead acid battery and the nickel-iron alkaline battery. Of the lead batteries there are two general types of plates, the Plante and the Faure. For a given output, the Plante is more costly, more bulky, and heavier than the equivalent pasted plate type. Thus far this type is more durable and better able to withstand the operating conditions incidental to car-lighting service. It is the type most used in car-lighting service, but some car-lighting engineers claim that the advantage it has had over the Faure type is decreasing with the increased cost of labor and improved methods for battery protection. The nickel-iron alkaline battery is of comparatively recent development and is radically different from the lead acid battery. It is light in weight and mechanically rugged.

The cost of maintaining batteries constitutes the largest single item of expense in the maintenance of car-lighting equipment, and the entire development of regulators or apparatus for battery protection while the car is enroute has been made with a view of prolonging the life and reducing the cost of maintenance. However, good standard practice for handling batteries is also essential if this cost is to be kept within reasonable limits.

With the present design and construction, the cleaning period is comparatively short. By a change in design the same capacity could be maintained and yet the space for sediment could possibly be doubled, thus greatly prolonging the cleaning period, insofar as it is based on this particular feature. Some manufacturers are now endeavoring to produce a battery which will not have to be removed from the car for cleaning during the life of the positive element, or at least to prolong the period of time between the cleaning far in excess of present practice.

The control of the generator output while the car is enroute has offered one of the most difficult problems to be overcome, since the life of battery and lamps depends to a large extent upon regulation.

Without the proper protection, the battery life may be only a third of what it should be. In a similar manner also the cost of maintaining the generator depends upon the regulation.

Regulators

The duties of the regulator for car-lighting service are: (1) To connect the battery to the generator at the minimum speed and voltage for which the machine is designed to operate and to disconnect the battery when the speed and voltage fall slightly below the first mentioned value; (2) to provide a variable voltage to charge the battery at the proper rate, which is determined by the state of charge, and at the same time carry the lamp load, in the event it is turned on, up to the capacity of the generator; (3) when the battery has attained a full state of charge, the regulating means must prevent further charge thereafter, leaving the generator capable of supplying current to lamps or other translating devices; (4) to provide constant voltage on lamps while the car is in motion or at rest.

There are two types of regulators in general use, designed with the view to meet these requirements: First, ampere hour meter control; second, potential control. The first mentioned method charges the battery by starting at a high rate, which is gradually modified to a predetermined lower rate, and when a predetermined number of ampere hours have been put into the battery as indicated by the meter, the potential is reduced by the regulator sufficiently to prevent further charge. With this method it is necessary, for proper battery protection, to maintain the ampere hour meter in step with the state of charge of the battery.

It is apparent that the proper battery protection depends not only on the proper functioning of the meter itself, but also upon the battery remaining in normal condition in order that the battery and meter may remain in step with each other. Owing to battery characteristics and operating conditions, the meter does not always indicate the true state of charge.

In the second method of charging heretofore referred to as "potential control," inherent characteristics of the battery are taken advantage of to govern the charging rate, and when the battery has attained a full state of charge, to prevent further charge thereafter. With most potential control equipments, a current limit feature is embodied with the potential regulator to hold the maximum current to a value consistent with the generator capacity.

Many forms of potential control equipment have been placed on the market, most of which operate at potentials such that in the course of charging, the battery is caused to gas. In 1913 and 1914, efforts were made by the Rock Island to operate equipment at a maximum voltage of 2.3 volts per cell. At the beginning the experiment was found to be a failure, as in many instances cars on most runs arrived at terminals with the batteries in a decidedly discharged state. There were, however, cars in fast main-line service on which the batteries remained in a full state of charge and at the same time were not being overcharged, the batteries requiring flushing on an average of about every six months. This was encouraging and led to investigations which developed that the failures were not due to the fact that the low voltage would not keep the batteries charged, but resulted from the fact that this voltage of 2.3 volts per cell was not attained except at very high train speeds. In one test covering a period of five hours, the equipment maintained full voltage and load for less than 10 per cent of the running time. On the face of the evidence it looked as though a larger generator designed to give full voltage and load at a lower train speed would be required, but fortunately after further investigation it was found that with certain refinements in the regulating device, a lower cut-in speed could be secured.

A test made with an improved regulator with the same generator that was used on the previous test and over the same run, showed the following comparison:

Full load—Old regulator—35 miles an hour.
Full load—Improved regulator—24 miles an hour.
Full load time in 5 hours—Old regulator—10 per cent.
Full load time in 5 hours—Improved regulator—41 per cent.

In this case the capacity of the unit was increased 300 per cent.

The net results realized from the use of the improved regulator are increased capacity of the unit due to obtaining generator output at low train speed, and increased battery life, which is brought about by the following:

(A) The work imposed upon the battery of furnishing energy for the lights is greatly reduced by the increased working time of generator, and also by the fact that the current for the lights is supplied by the generator, and not by the battery, at all times after the generator cuts in.

(B) The battery is charged at the proper rate to prevent gassing and overheating with the attendant ill effects.

(C) The battery is protected from overcharge and the forming away of the reserve lead in the battery elements.

Even though only a part of the Rock Island equipments have been improved, the cost of operation and maintenance per car per month has not increased, in spite of the increased cost of labor and material, and a very large part of the savings is attributed to the better protection provided for the battery.

Photo Copyright by Underwood & Underwood, N. Y.

A Howitzer on an American Work Train at Kypeselga in Russia

Draft Gear Design and Maintenance

General Foremen in Convention Discuss Spring and Friction Draft Gears and Their Function

IN addition to many other important questions, the subject of design and maintenance of draft gear was considered at the fifteenth convention of the International Railway General Foremen's Association, held in Chicago on September 2-5. Several excellent papers on the subject were read, abstracts of which are given below.

DRAFT GEARS

BY J. W. WOMBLE

An ideal draft gear should have not only a suitable friction capacity and travel, but it should also be positive in its nature, simple in design, of few parts, readily applied and removed from the car, and applicable to the standard pocket space. It should be so constructed that a buffing shock greater than sufficient to close the gear will not be apt to injure it in any way, that is, after the gear becomes solid the blow should be transmitted to the draft sills without injuring the draft gear itself, or without it being necessary for the horn of the coupler to go home against the striking plate in order to relieve the shock.

The design of the gear should be such that the frictional load is not dependent upon the speed at which the gear is closed nor should it be dependent on the internal parts of the gear being carefully machined or requiring considerable care in fitting them together. It should be so made that it could be applied and removed from the car and the repair parts substituted, if necessary, by ordinary labor. It ought also to have sufficient area of friction faces to bring the pressure per square inch to a figure that will insure it having a satisfactory life in service.

The term friction draft gear is somewhat of a misnomer, as it is both draft and buffing gear, the latter being undoubtedly its most important function. If the draft and buffing features could be divided and considered separately, no doubt better results could be obtained. Unfortunately, this is not feasible, and the draft gear must necessarily take both of these requirements into consideration.

On this account it is advisable that a draft gear have a low capacity at the start of its movement in order to get the best results in pulling service. This only utilizes a small part of the capacity of the gear, and the capacity at that part of the travel should make it possible to easily start the train. After about the first inch of travel, the capacity should rise quite rapidly, but uniformly, to its ultimate limit in order to absorb a large part of the buffing blow without causing too much shock to the draft sills.

COMMITTEE REPORT

The committee recommends that: The committee's data in the future be obtained from both laboratory and actual service tests. That a large proportion of gears installed be stencilled with date applied and notice to employes to report conditions and all facts whenever they are removed, this information to be used in connection with actual service tests. That draft gears be inspected and maintained at intervals depending on the kind of service. That poor gears be gradually eliminated and good gears be confined to as few as possible. That the General Foremen's Association express its willingness to aid the supply men in developing the best possible protection to the car against shock. That so far as possible the length, width and height of gears be brought to a standard so as to eliminate the different sizes of coupler yokes now required without sacrificing the gear efficiency.

The report is signed by W. W. Scott (D. L. & W.) and C. F. Bauman (C. & N. W.).

MAINTAINING DRAFT GEARS

BY L. A. NORTH,
Superintendent of Shop, Illinois Central, Burnside, Ill.

In taking up the subject of draft gears, it is with the object of bringing to the attention of the general foreman, particularly the general foreman of the locomotive department, the necessity of spending more time in the car department to obtain such knowledge of car department matters as will be of benefit to them when they are advanced to the next step in the ranks, that of master mechanic.

They should thoroughly familiarize themselves with all matters pertaining to the repairs to cars, particularly the draft rigging. From observation, the logical place to examine the draft gear and the results derived from the application of the different designs of draft gears, is the repair track and the scrap pile. The damage caused from shock and rebound, due to defective draft gear, runs into millions of dollars every year. No matter what make of gear is applied to a car, unless the gear is maintained in working order, it will not properly function nor perform the duties that the designer or builder claim for it. There are a number of different friction draft gears on the market today which under test will demonstrate to the observer that the gear will perform just what the manufacturer claims for it, viz.: absorb the shock and decrease the rebound, but, as stated before, unless sufficient attention is paid to the maintenance and upkeep of this gear, the money expended is money thrown away.

A visit to the repair track will show end sills and draft arms broken and bent, center sills buckled up and car underrigging in a generally dilapidated condition. In looking for the cause as the usual thing we find the draft gear worn out, inoperative and parts missing, so that the casual observer's first opinion would be that the draft gear did not perform the duties that it was designed for.

Some railroads have made it a practice to drop the draft gear when the car is placed on the repair track and make a thorough examination of the different parts of the gears to determine what parts need renewing or repairing, with the result that the gear has a chance to function properly and perform the work that it was originally designed for.

With the introduction of the heavy capacity cars, it has become more necessary than ever to pay particular attention to the draft rigging. Hump service is much harder than ordinary switching service on draft gear and has made it necessary to fit cars engaged in this service with substantial draft rigging and draft gear that will properly take care of and absorb the shock and rebound which comes from this service. A visit to any of the hump yards will further verify this statement and will illustrate the necessity of properly providing a substantial draft gear and maintaining it in good repair at all times.

DRAFT GEARS

BY C. F. BAUMAN
Chicago & North Western, Winona, Minn.

The draft gear is a cushioning device applied to cars, and so situated that the rear end of the coupler rests against it in such a way that when the couplers meet one another in the case of cars colliding, the draft gear has a limited movement or travel under resistance, according to its capacity, so as to soften or cushion the shock on the cars and their lading. It is also secured to the coupler by a yoke so as to use the cushioning effect to prevent the pulling shocks from doing damage. I think a better name for the draft gear would be the car protector.

My study of broken or damaged cars leads me to believe that if a draft gear of sufficient capacity to care for the buffing shocks is used it will be ample to care for the pulling forces, as I cannot call to mind a case of damage due to pulling unless the parts were first damaged and weakened by the buffing shocks, excepting very rare cases of coupler yokes breaking under pulling strains where the yokes were made of the old light section of 1 in. by 4 in. bars, and even of lighter section. The new standard yoke section of 1¼ in. by 5 in. has put a stop to this failure and there are very few of the old light sections of yokes in use now. I would strongly recommend replacing these weak yokes with the newer standard as early as possible. The cost would be slight, compared with the saving effected.

Buffing Shocks

If a study is made of the car failures as they pass over the repair shop tracks and the piles of scrap material collected from the repairs to the cars, the necessity for improved draft gear is very plain. Couplers and their parts are found broken, bent and upset, due to the shocks they receive. If a draft gear could be found to assist the car in absorbing these shocks, couplers would wear out instead of being discarded for the defects mentioned above. This would result in a great saving to the railroads.

The following damage to freight cars are common sights to all of us who have to supervise repairs to cars: Ends of cars pushed out by the lading, broken draft sills, broken draft arms, broken center plates, broken center pins, broken and bent steel center sills, broken body and truck bolsters, broken oil boxes where the car has not been derailed. The sides, roofs and superstructures of box, stock and other cars of the house type construction are also often found in a racked and loose condition, all of which is caused by the parts mentioned being forced to do the work of the draft gear. If the shocks were kept out of the cars all these items would have to wear out, which would take a long time. Applying a draft gear that will make it possible to move the cars from point to point without this destructive effect, or that will at least make a material reduction in it, would be an economical measure.

Types of Draft Gear

There are a large number of different types of draft gears in service, a few of which are enumerated below: One of the old designs uses a single spring 8 in. by 7⅞ in., with a front and rear follower, connected to the coupler with a yoke. The spring has a capacity of 30,000 lb. with a travel of 1¾ in. The cushioning value of this assembly is very low. It has no absorbing capacity, as all springs simply store up the energy until the pressure is taken from them, when it is returned with the same force that was required to close them. There are very few cars in service that are equipped with this single spring type. There are also spring draft gears made of two springs, some in tandem and others in twin assembly. They are made up generally of two different sizes of springs. The smaller type consists of two 6½ in. by 8 in. springs, having a combined capacity of 38,000 lb. and a travel of 1¾ in. The capacity and travel are both insufficient to protect the cars and the use of this gear should be discontinued. Other designs are the tandem and twin spring gears made up of two 8 in. by 7⅞ in. springs having a combined capacity of 60,000 lb. and a travel of 1¾ in. The recoil of these heavier springs is such that it is nearing the danger line in its reaction in long trains so that to use more spring capacity would in my opinion be a mistake.

A large number of different types of friction draft gears are in use, some of which are doing good work. There are a few essential features of the friction gears which I will comment on. Since a large committee of prominent mechanical railroad men appointed to design the 100,000 cars purchased by the administration decided to use friction draft gear, also in view of the fact that practically all new car specifications include friction gear, and considering the many thousands of old cars that have been reinforced with steel underframes or metal draft arms equipped with friction draft gear, the spring gear may be eliminated and the discussion confined to the friction type.

Draft Gear Specifications

While the committee performed excellent work in preparing the specifications and designs for the 100,000 freight cars for the Railroad Administration, and this paper should not be considered as criticising in the least sense, in my opinion there are some features of the draft gear question that could have been arranged so as to give the draft gear manufacturers a better chance to build to meet the conditions. For instance, five different makes are named as being satisfactory, but they are required to be interchangeable without changes in the car, so that in case of failure any one of the five kinds could be used to replace the defective one.

This would be ideal if it is granted that this application is perfection in draft gear design, but it is doubtful whether the draft gear manufacturers are willing to admit this. In fact, the manufacturer of one of the five gears used on these cars has several thousand cars equipped with a gear not confined to the spacing and travel specified for the government cars that will furnish double the protection to cars that it is possible to get with a gear travel of 2¾ in. They have given highly satisfactory service for several years and have passed the experimental stage.

One good point in the interchangeability of the gears is that in the course of time it should be possible to learn the relative service value of these five types, and get nearer to a standard by discarding the short lived ones; however, the demands on the draft gear change from year to year so that new developments in draft gear design may be looked for as the demands increase.

Increase in Car Loaded Weights

It is only a short time since the 80,000 lb. capacity car, which would weigh about 125,000 lb. on rails when loaded, was the heavy type. This was followed by the 100,000 lb. capacity car weighing 150,000 lb. on rails when loaded. Next came the 70-ton or 140,000 lb. capacity car which loaded weighed 200,000 lb. The 90-ton or 180,000 lb. capacity car came next, with a total loaded weight of 250,000 lb. The next heavy capacity car to make its appearance is the 120-ton or 240,000 lb. capacity car with a loaded weight of over 300,000 lb. When it is understood that these increases in rail loads per car all came into use during the last 15 or 18 years, and the wide difference in the amount of energy developed by these different weights moving at two or three miles per hour, the need for improved draft gear will be clear to all. Hence, I believe it would be a wise move to give the draft gear manufacturers more to say as to the space required in which to apply the device instead of confining them to 12⅞ in. between the draft sills and 24⅝ in. between the faces of the draft lugs.

Capacity Defined

The Railroad Administration specifications for draft gears call for a minimum capacity of 150,000 lb. with a maximum travel of 2¾ in. Stating capacity in pounds is misleading, as it only gives the final closing pressure, and it is possible to have the first 2½ in. travel of the device with a capacity limited to 20,000, or 25,000 lb., and the last ¼ in. movement might require a pressure of more than 150,000 lb. to close the device. This would make a very poor draft gear for destroying shocks, as the first 2½ in. travel would offer very little resistance to the forces and the last ¼ in. would not have time in which to act.

To make the capacity question clear, the Mechanical Committee of the United States Railway Administration gave the following definition of a 150,000 lb. capacity draft gear. It is the sense of this committee that a 150,000 lb. draft gear should be defined as one that will sustain a drop of 16 in. (including the travel of the gear) of a 9,000 lb. weight without shearing the rivets of one or both lugs, which are to be secured to suitable supporting members by nine ½ in. rivets of .15 carbon or under, driven in 9/16 in. drilled holes. This definition clears the question as it expresses the capacity in foot pounds, which is the correct unit to use, as in order for the gear to stand this drop without shearing the rivets it must offer a high resistance throughout its entire travel. This test requires the gear to have a capacity of 12,000 ft. lb.

This specification could easily be raised to 18,000 ft. lb. developed with the 9,000 lb. drop hammer. A gear that will develop 18,000 ft. lb. capacity, resting on a solid foundation, will show an increase of 66 2/3 per cent when secured to a rolling foundation such as a car, and would, therefore, be equal to 30,000 ft. lb. when applied to the car.

GEAR TRAVEL

The question of coupler or draft gear travel is of great importance, as the capacity of the gears can be increased or decreased as the travel is increased or decreased. The Railroad Administration's Car Committee in regulating the gear movement, specified that the maximum travel should be 2¾ in. It would be better if this regulation was changed to make 2¾ in. the minimum instead of the maximum. This dimension has so much to do with draft gear capacity that a committee of one car man, one air brake man and one operating man appointed to investigate and report back to this association the maximum amount of travel that could be allowed would be a step in the right direction. I am sure that this dimension can be increased.

INSPECTION AND ADJUSTMENT

The draft gears should be applied to the cars in such a way that their different parts can be readily seen and inspected by the men who are assigned to this work. Some are applied so that it is almost impossible to inspect them. Manufacturers should give more attention to this feature. If possible, the gears should be equipped with some practical and quick means of adjustment to take up the wear.

DRAFT GEAR INVESTIGATION

Some of the draft gear manufacturers have especially equipped laboratories for demonstrating purposes and some of them have made exhaustive tests not only of the draft gears but of couplers protected from the shock by the use of different gears, also sills of different weights per foot and of sills having the center line of draft different distances off from the center line of the draft channels, the results of which prove conclusively the cause of many failures in car design. The manufacturers are to be commended for carrying on this research work. If a car user is having trouble with any part of a car that is due to the shocks it receives in handling, these companies will duplicate that section of the car and destroy it in the laboratory, furnishing readings of the work so that the best remedy can be applied.

MAINTENANCE OF DRAFT GEAR

It is only recently that I have been impressed with the importance of keeping the draft gear repaired so that it will be in condition to perform its whole duty at all times. It must be remembered that a car having a good high capacity draft gear colliding with a car having a low or weak gear helps out the car with the weak gear as the amount of protection that each car gets is the sum or combined value of the two. Every car turned away from the repair track with a good draft gear helps every other car it comes in contact with.

The forces applied to cars when they collide, up to the closing point of the gear can only equal the pressure required to push it closed or solid, but if double the energy required to close the gear is applied, this multiplies the pressure on the car by ten. For example, if two cars equipped with 60,000 lb. capacity draft gears should collide with a force that would just close the gears the pressure on the car would be 60,000 lb., but if the colliding forces are doubled the pressure on the car would raise to 600,000 lb., which in most cases would damage one or both of the cars so as to send them to the shops.

With these facts before us, I am convinced that no car should be allowed to leave the shop tracks until the draft gear is put in condition to do all the work that it is constructed to perform. By keeping the draft gear repaired, damaged cars will be reduced, thus effecting a saving and resulting in more efficient equipment. A concerted move along this line, I am convinced, will surprise all of us. The improvement cannot all be made at one shop, as this would create a congestion of defective cars, but let everybody start and all roads will be on a better footing very quickly.

I would recommend discarding the low capacity gears and substituting the better types as fast as possible. The cost of changing would soon be returned by increased car efficiency. I am of the opinion that where cars are repaired in large numbers a special crew of men in charge of a competent leader should be assigned to draft gear maintenance. The men in charge should become familiar with the different makes of draft gear so as to intelligently maintain them.

When draft gears are new or have been repaired the date of application or repairs should be stenciled on the draft sill where it could be plainly seen by the inspectors. At the expiration of three years (this may be changed to a longer period as soon as experience proves it to be good practice), the car or cars should be shopped for another draft gear overhauling. In case of a car being found on a foreign line with the date showing that the three-year period had expired, the road having the car should be obliged to shop it and overhaul the draft gear, billing the owner for the cost of the work. Improper repairs by foreign lines should be penalized by the cancellation of their bill. These few rules worked out more in detail and put into effect will reduce the bad order cars much quicker and in a more permanent way than increasing the number of car repair men and continuing to overlook the draft gear until the car damage forces it out of service for extensive repairs. Keeping the draft gear in shape would cost only a few cents and would save large expenditures for broken parts on account of the draft gear being neglected.

DISCUSSION

There was some difference of opinion as to the advisability of inspecting draft gears at regular intervals. J. H. Hott (A. T. & S. F.) objected to the periodical overhauling upon the grounds that it would have a tendency to cause lax inspection. L. A. North (I. C.) contended that a thorough inspection is necessary to insure that the gears are in serviceable condition. The advantage of draft gears of high capacity was generally recognized by the members. M. H. Westbrook (Grand Trunk) brought out the decrease in the ultimate strength of the draft members which results from locating the center line of the buffing and pulling stresses off the center line of the sills. The usual construction of setting the center line of the gear 2 in. from the center line of the draft members decreases the strength 40 per cent.

Car Inspectors and Foremen Meet

Discussion of the Working of the Rules of Interchange and Changes Proposed by Arbitration Committee

THE nineteenth convention of the Chief Interchange Car Inspectors' and Car Foremen's Association met at the Planters Hotel, St. Louis, Mo., with W. J. Stoll, chief interchange inspector at Toledo, Ohio, presiding. The first session was opened with prayer by Captain Arthur Andrews of the Salvation Army, and the association was welcomed to the city by L. McDaniel, prosecuting attorney, whose address was responded to by T. J. O'Donnell.

PRESIDENT'S ADDRESS

In his address as president of the association, Mr. Stoll spoke in part as follows: The discussion of the M. C. B. rules and other matters pertaining to the construction and maintenance of cars is an important question and one which requires sound judgment and executive ability. The changes in the M. C. B. rules of interchange which take effect October 1, while not numerous, are quite important. The rules now in effect have not as yet been discussed by this association and I hope the members will take advantage of this opportunity to discuss them. I would also call attention to the fact that the loading rules have been rearranged and a discussion of them would be interesting and beneficial, as many cars are being improperly loaded. This association might well recommend that shippers should be furnished with copies of the loading rules. Because of the conditions which have been brought about by the war, such as pooling certain portions of the equipment, routing cars away from home where material was not available to make proper repairs, insufficient help, etc., it is necessary for this association to put forth its best effort to remedy conditions.

The report of the secretary-treasurer was read; it showed the total membership to be 508 and a satisfactory balance in the treasury.

DISCUSSION OF RULES OF INTERCHANGE

At the session on the afternoon of September 23 the discussion of the Rules of Interchange was begun. An abstract of the discussion which followed the reading of the rules is given below:

Rule No. 2—Empty cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge.

T. J. O'Donnell (Buffalo): I should like to ask what constitutes a serviceable empty car?

E. Pendleton (C. & A.): My interpretation is that a serviceable car is one that is suitable for any commodity.

Mr. O'Donnell: Should no cars be offered in interchange with defects though they require only light repairs?

F. C. Schultz (Chicago): I believe that in order to expedite traffic minor defects should be ignored.

Mr. O'Donnell: How would you handle coal cars with hopper doors not in serviceable condition?

Mr. Schultz: The repairs should be made by the receiving line.

G. Lynch (Cleveland): A car that must be sent to the repair track is not a serviceable car and the receiving line can refuse it or accept it, as it chooses.

T. J. O'Donnell: I consider that under present conditions it is necessary for the joint inspector to specify where the cars are to be repaired and distribute the bad orders among the various roads.

J. J. Gainey (Southern): I agree with Mr. O'Donnell in his interpretation of Circular No. 37.

F. Trapnell (Kansas City): We have received instructions from the Railroad Administration to regard as serviceable any car that requires less than 20 man hours to put it in condition for any commodity, and we have been working under this interpretation.

F. C. Schultz: It is necessary that we do whatever the local conditions demand to move the traffic.

T. J. O'Donnell: There should be some general ruling which could be applied regardless of the shop facilities at the interchange point.

J. J. Gainey: I believe that all cars having defects that can be repaired on the light repair track should be accepted in interchange.

G. Lynch: The rules make a very definite distinction between the handling of loaded and empty cars. Loaded cars must be accepted by the receiving line, and run, repaired or transferred. On the other hand the empty cars can be rejected if not in safe and serviceable condition. This rule has made it easy for roads that originate a great deal of traffic to get cars off their lines while roads that offer a great many empty cars to connections have suffered from the accumulation of bad order cars which they were unable to dispose of without repairing them.

In an effort to secure an agreement as to the meaning of the rules it was moved that a car which must be placed on the repair track was not a serviceable car within the meaning of the rule. This motion was lost. A second motion stating that a car requiring not over 20 man-hours' work should be considered serviceable was also lost. A motion was made that the exceptions in Rule 2, paragraph *f*, should govern the acceptance of empty as well as loaded cars, but this motion also was rejected. The discussion showed that there was a wide diversity of practice in different sections of the country which was due in part to lack of uniformity in the orders issued by the Regional Directors. A committee was appointed to consider the matter further and present a report to the convention.

CHANGES RECOMMENDED BY THE ARBITRATION COMMITTEE

After the prolonged discussion on Rule 2, the association proceeded to consider the changes in the rules as recommended in the report of the Arbitration Committee presented at the 1919 convention.

Rule 32—(Delivering line responsible) Damage to any car (including cars on ferries or floats) if caused by (a) Derailment, (b) Cornering, (c) Sideswiping, (d) Collision or impact other than that occurring in regular switching, (e) Handling of cars with broken or missing couplers, or couplers out of place, (f) Colliding with or shoving over bumping post or other fixed obstruction, (g) Shifting of loads from other cars, (h) Overloading, (i) Explosion, (j) Collapsing buildings or other structures on right of way, (k) Unconcealed fire damage, (l) Flood, (m) Storm where car is derailed or destroyed, (n) Failure to close hopper or drop doors before moving car.

F. C. Schultz: The rules now in force have made it possible for roads to break up cars in switching and yet hold the owners responsible for the damage if the trucks were not derailed. I think the new rule will be an improvement as it will change this situation.

H. W. L. Porth (Swift & Co.): The intent of the changes is to clarify the meaning of the indefinite term "wreck." The judgment of the inspector will still enter, however, in determining what constitutes regular switching.

G. Lynch: The terms "collision," "impact" and "regular switching" are still indefinite and even the new rule will be hard to interpret. In case of missing material the car owner will no doubt contend that the parts have been stolen while the handling line will assert that they have been lost in fair service.

J. P. Carney (Michigan Central): I believe the changes are intended to put the responsibility for damage to weak equipment on the car owner.

F. H. Hanson (N. Y. C. West): I move that it is the sense of this meeting that if cars are damaged or broken in two the owner is to be held responsible for the damage if the trucks are not derailed and the car is not cornered or sideswiped. (The motion was put to a vote and carried.)

Rule 33—Owners will be responsible for the expense of repairs to safety appliances where not involved with other delivering line damage, except damage to running boards on tank cars when sideswiped or cornered.

A. Herbster (N. Y. C. West): In the past a running board on tank cars had been considered a part of the safety appliances and the owners had been held responsible for damage if no other part of the car was involved. The Arbitration Committee, however, ruled that the running boards on tank cars cannot be damaged in fair usage and this rule has been amended to conform with that interpretation.

H. W. L. Porth: Safety appliances are often damaged when no other injury is done to the car and for that reason it hardly seems proper to hold the owner responsible.

Rule 66—(Owners responsible) Periodical repacking of journal boxes, regardless of the responsibility of delivering company for change of wheels, journal boxes or journal bearings. No charge shall be made for repacking unless all boxes are repacked. No charge shall be made if the repacking is done within nine months from date stenciled on the car. If car bears no stenciling showing date of previous repacking, all journals may be repacked if necessary and charged for.

(*a*) All journal boxes shall be repacked with properly prepared packing (new or renovated) at least once every 12 months, at which time all packing will be removed from the boxes and the boxes cleaned; dust guards to be renewed when wheels are changed.

(*b*) The date and place (railroad and station) where the work is done must be stenciled on the car body near the body bolster at diagonal corners in one inch figures and letters, using the same station initial that is used for air brake stencil.

(*c*) This work to be done as far as possible when cars are on repair track undergoing heavy repairs. Cars which have not had boxes repacked within nine months will have all boxes repacked and the record stenciled as above.

(*d*) This does not contemplate any change in the intermediate packing of boxes when it is necessary to do so. No change should be made in the stenciling unless all boxes are repacked.

J. J. Gainey (Southern): At the present time repacking of journal boxes is often done by removing the waste from the box, shaking out the dirt and short fibers and then replacing it. Such practices should be discontinued as they do not comply with the requirements of the rules.

The opinion was expressed by several members that periodical repacking of journal boxes would improve the operating conditions and effect a large saving. It was suggested that improper repacking could be eliminated by requiring the work to be done only at stations which are equipped with apparatus for reclaiming oil and waste.

Rule 88—In order that repairs of owners' defects may be expedited as fully as possible foreign or private line cars may be repaired by the handling line by using material from their own stock instead of ordering material from the car owner as prescribed by Rule 122 in which event the repairing line must issue its defect card for the labor only of correcting such improper repairs and defect card should be so marked.

In case of delivering line defects, defect card shall be issued for both labor and material for correcting the improper repairs.

F. C. Schultz: I believe it is advisable for the railroads to return private line cars to the owners for repairs as the average railroad repair track is not equipped to make proper repairs to these special types of cars.

F. Trapnell: There has been some criticism of the private car owners because of the fact that these companies often removed parts applied by the railroads after the car was returned to the owner. This inspection is necessary to insure that insulation in refrigerator cars, or other essential parts, have been properly applied.

H. W. L. Porth: It has been our experience that in most cases cars are returned when in need of repairs and the private car lines in general encourage this practice as they prefer to do the work themselves.

[At the time of going to press the convention was still in session, making the publication of a complete account of the proceedings impossible in this issue. The account of the remaining sessions will appear in a later issue.—Editor.]

Bad Order Coal Car Situation

Producers Complain of Car Shortage; Conditions Not Serious, Says Railroad Administration

The relation of the bad order car to the production and transportation of coal, and the impending possibility of a coal shortage, was discussed recently before the Senate committee investigating the coal situation. The situation, so far as it is affected by the repair of cars, as outlined by Frank McManamy, assistant director of the Division of Operation of the Railroad Administration, appears to be well in hand and is not serious. He says in his statements to the Senate committee during the first week in September that cars can be furnished in sufficient numbers to meet the requirements of the coal producers or other shippers if the demand becomes urgent.

That this optimistic view is not shared by the coal producers is indicated by the statements of John Callahan, traffic manager of the National Coal Association, in his testimony before the Senate committee late in the month of August.

Transportation is Insufficient

The Railroad Administration is not furnishing enough transportation to insure production and shipment of sufficient bituminous coal to meet the requirements of the nation this year, stated Mr. Callahan.

"Car shortages caused the coal mines to fail to produce 5,900,000 tons of coal during the weeks ending August 2 and August 9," Mr. Callahan said. "This is sufficient coal to supply the requirements of the state of New Jersey for ten months. The difficulty today is a transportation deficiency and not a car shortage alone. Coal is one of the few commodities which cannot wait on transportation. It is physically impossible in many instances to bring coal to the surface and store it. Moreover, the proper place to store coal is at the point of consumption, where it will be available when required for use. Railroad cars must be ready when the coal is brought out of the ground.

"Many mines are idle today on account of no cars. Two hundred and eighty-five mines were idle because of car shortage in one West Virginia district during the week ended July 26. This was before the shop men's strike. Ninety-seven mines in this district failed to go to work in one day while many others only worked part time that day.

"The total bituminous coal lost through lack of railroad cars at the mines from the week ending June 7 to the week ending August 9, inclusive, was 12,251,762 tons, distributed by weeks as follows—June 7, 338,996; June 14, 655,190; June 21, 936,662; June 28, 644,149; July 5, 385,485; July 12, 428,359; July 19, 1,146,075; July 26, 1,764,264; August 2, 2,311,402; August 9, 3,591,180. This means 245,000 cars, or 7,000 train loads. This is more than six months' supply for all of the New England states; and this loss occurred in 10 weeks only.

"Since July 12, this shortage has been increasing by leaps and bounds. These figures are based on the United States Geological Survey reports, which indicate that whereas for the week ended July 19, where Director General Hines chose to close his recent report to the Senate, the loss on account of car shortage was 7.4 per cent of full time output, the loss on August 9 was 22.5 per cent; this in the face of statements by the Railroad Administration to the effect that conditions are not now normal. In other words, the loss because of no cars at mines has trebled in three weeks, and is now on a parity with the ordinary shortage during severe winter months when the railroads are handicapped by congestions and engine failures.

"The director general points out that 37,000 new cars have been built, of which 17,000 have been put in service. If all of these 37,000 cars had been in service during the week of August 9 there would still be a shortage of 34,000 cars during that one week alone; but these cars are not yet in service and they are going into service very slowly. The director general states they are being stencilled and lettered and placed in service. He does not say how rapidly. In one instance recently where 2,000 of these cars were being lettered, the work was being done at the rate of 10 cars per day; on this basis, more than seven months would be necessary to place this one batch of 2,000 cars in service."

Mr. Callahan said that the movement of traffic is not adequate to the demands of coal to-day, and presented a table indicating that the average miles per car per day of all cars during 1915 was 24.4 miles. "The mileage per car per day for all cars in 1916," he continued, "was 26.9 miles. It declined in 1917 to 26.4 miles per day, and in 1918 it was 24.9 miles per day, but during the first six months of 1919, the average miles per car per day for all cars declined to 21.5 miles. This means a much lower mileage on coal than the average figures shown. If all traffic is moving slower, it is natural to suppose that coal moves much more slowly."

Mr. Callahan also introduced charts showing bad order coal cars by weeks from April 5 to July 19, and indicating that whereas there were 66,192 coal cars in bad order on April 5, on July 5 there were 105,295 of such cars requiring repairs, a rise in the percentage from 6.5 to 10.4 per cent of the total coal cars in the country. He also stated that "while the Railroad Administration statements recently set forth that there were 208,531 bad order cars at the time Mr. Hines's report was written (August 14) and while the director general stated that 'a large number of cars awaiting repairs are held for only light repairs which can be speedily applied' the facts are there were 135,895 cars requiring heavy repairs, and 72,636 cars requiring light repairs at the middle of July. This figure includes all cars and it is assumed that there are relatively as many coal cars requiring heavy repairs as other cars requiring heavy repairs." At the time to which reference is made 47 per cent of these 208,531 cars, or 98,139 cars were coal cars in bad order; and that on August 2, there were still 96,758 of these coal cars to be repaired.

"There are proportionately more coal cars in bad order to-day than closed cars," said Mr. Callahan. "Of a total of 1,183,490 closed cars, 95,928 or 8.1 per cent were in bad order on July 12, as compared with 98,139 bad order coal cars, out of a total of such cars of 974,547 or 10.1 per cent coal cars in bad order. Repairs to coal cars are being neglected through preference to other cars. Moreover a figure of 10 per cent of coal car ownership in shop is abnormal. There should not be to exceed 5 per cent of the total number of coal cars in shop under ordinary good railroad management.

"COUNTRY FULL OF BAD ORDER CARS"

"The country is full of bad order cars. They impede the movement of freight through railroad yards in certain districts and are backing up the current of traffic. Moreover 8 to 10 per cent of the 62,000 locomotives owned by the railroads under federal control are now in the shop for classified repairs. These 5,500 or more engines, according to indications, will be needed quite early this winter. They could be used now in avoiding blocking coal mines with loaded cars. If these engines are not repaired at once, they may, when required for use, be in just the same condition so many cars are in today."

Mr. Callahan also quoted some correspondence with the Railroad Administration in which Mr. Hines said:

"There appears to be quite a disposition on the part of coal operators to exaggerate the argument about car shortage. I hope this disposition will not be persisted in because necessarily if the situation should be habitually exaggerated we would have to take issue with the claims thus made. It would be unfortunate for the Railroad Administration and the coal operators to get into a controversy on this subject because the controversy would tend to encourage people who are postponing the purchase of coal to feel that the coal operators are not justified in urging the purchase of coal. Naturally we prefer to see the purchase of coal expedited so it can be handled before the fall and hence we prefer not to say anything which will tend to encourage purchasers to hold off. Yet we could not remain quiescent under repeated assertions exaggerating the car shortage situation and incorrectly stating the policy of the Railroad Administration as to utilizing and repairing its equipment.

"What I would like very much to do is to get the practical co-operation of the coal operators in notifying us of any serious car shortages that exist in specific regions. Of course these matters are reported through our regular channels and are supervised accordingly, but a systematic and accurate check of the matter from the standpoint of the coal operators would be an additional safeguard of which we would gladly avail ourselves. Specific information along these lines conveyed to us will help us to handle satisfactorily a situation of common interest."

MC MANAMY DESCRIBES BAD ORDER CAR SITUATION

Mr. McManamy discussed the bad order car situation, saying the number of such cars is high at present but that the action which was taken by the Railroad Administration two months ago and which is still being diligently followed will, in his opinion, be sufficient to meet the demand for coal cars unless it reaches abnormal proportions, in which event the difficulty will be due not so much to car shortage as to the terminal facilities.

In July, 1918, Mr. McManamy said, 14.9 per cent of the locomotives were out of service for repairs and 798 were stored in serviceable condition. In January, 1919, there were 16.9 per cent out of service for repairs and 1,582 stored; in April, 18.4 per cent were out of service and 4,604 stored; in July, 17.9 per cent were out of service and 3,668 stored. Therefore, he said, the general condition of the locomotives today is better than at any time during federal operation or during the three years before and there is no ground for apprehension. There will be sufficient motive power to handle all the business offered to the maximum capacity of the terminals.

With respect to freight cars, Mr McManamy said, the situation is somewhat different. On July 1, 1918, there were 167,403 bad order cars, or 7.1 per cent. The force of shopmen was then at its maximum and was working 70 hours a week. In December the number of bad order cars had been reduced to 130,506, or 5.4 per cent. After the armistice the hours were reduced from 10 a day for 7 days a week to 9 hours and 6 days a week and on December 9 to 8 hours a day. This was fully justified, he said, by the prospective decrease in business and was necessary both because of the severe strain under which the employees had been working and because of the importance of reducing maintenance costs by reducing the amounts paid for punitive overtime. The decrease in business was sufficient to make it possible to maintain the low percentage of bad order cars up to March, at which time it was 5.2 per cent, which for the country at large, Mr. McManamy said, is an almost ideal condition. The necessity for further economy on account of expenditures for maintenance of equipment as compared with the test period made it seem advisable to make further reductions in car department forces and this was done by furloughing men at many points and by further reducing the car department hours. As a result the number of bad order cars began to increase in April and until it reached 8.7 per cent in July, a total of 215,953.

With the increase in business the shop forces were increased, first by increasing the work on the box cars to meet the early grain movement, and before the grain movement became heavy sufficient cars were provided to handle it as promptly as elevator capacity and terminal facilities would permit. Meanwhile, Mr. McManamy said, the low coal shipments could not be charged to the Railroad Administration because they were due to no market. Anticipating an increase in production the Railroad Administration on June 19 issued instructions to increase car repair forces and this was followed on June 27 by instructions that wherever the demand for coal cars made it necessary cars requiring light repairs should be given preferential attention. This was followed on August 16 by instructions to increase the hours of the car department forces to nine a day on all roads where the number of bad order cars was sufficient to keep the men profitably employed or where work could be furnished from connecting lines without excessive empty mileage, also to give special attention to grain cars, coal cars and refrigerator cars in sections where they would be most needed.

This action was begun, Mr. McManamy said, at a time when the loss of coal capacity was 41.4 per cent, of which 26.2 was on account of no market and but 3 per cent on account of car shortage. The effect had already become apparent in a reduction of 8,414 in the number of bad order cars and of 5,741 in the number of bad order coal cars. The number of employees was increased about 8,000 and their hours to nine a day, making an increase of 12½ to 15 per cent in the number of hours worked.

"The increase in bad order cars," Mr. McManamy continued, "is not at all due to a slowing up of the repair program. It is to a substantial extent due to the fact that since the close of the war the railroads are endeavoring to get their cars in better condition and are therefore sending cars to the repair tracks which at any time in the past four years would have been continued in service without repairs. They are also holding cars for heavy repairs which at any time in the past four years would have been put in service with comparatively light repairs and which, if the demand for cars becomes sufficiently urgent, can again be returned to service with comparatively light repairs.

"The strike also interfered seriously with the car repair program, but I think we can reduce the number of bad order cars very substantially in the next two months unless we have some unforeseen labor troubles—and I do not look for them."

Mr. McManamy also testified that 68,598 of the 100,000 cars ordered by the Railroad Administration have been built, of which 51,428 are in service and 17,170 in storage waiting to be stenciled, which is being done at the rate of 700 a day. The balance of about 31,400 cars is being turned out at the rate of 220 per day and includes 10,658 double sheath box cars, 12,075 single sheath box cars, 3,562 50-ton gondolas, 949 hoppers, 1,826 low side gondolas and 2,332 70-ton hoppers.

That there is reason to believe that the car shortage has reached considerable proportions is shown by the action of the Railroad Administration in the matter of hours of labor in car repair work. Although the number of cars repaired in May and June, 1919, was fully up to the normal number of cars repaired, the Railroad Administration gave instructions on June 20, 1919, that all car forces be increased to the full standard measure of 48 hours per week and that additional shifts be worked where the additional employees could be obtained and where they could be economically used. The showing naturally to be expected from the putting into effect of these instructions was hampered in July by the intervention of practically a double holiday, and, of course, was temporarily prevented in August by the strikes of a large number of shop employees. Conditions having now been restored to normal, it is expected that these instructions will promptly show a most favorable result. Further than this, the Railroad Administration instructed on August 16, 1919, that all car forces be put on a basis of 54 hours per week.

STATUS OF U. S. R. A. OPEN-TOP CARS

Director General Hines has a statement in connection with the car supply situation, giving the status as of August 26, 1919, of the open-top cars contracted for by the Railroad Administration. Of the total of 50,000 open-top cars mentioned, 45,000 are coal cars.

Open-Top Cars

	55-ton Hopper	Com. Gond.	70-ton Hopper	70-ton low side	Total
Number ordered	22,000	20,000	3,000	5,000	50,000
Completed and in service August 26	12,935	8,051	762	2,397	24,145
Completed and in storage August 26 (the numbering and placing of these cars in service is now in progress)	8,186	8,498	.. ..	794	17,478
To be built	879	3,451	2,238	1,809	8,377

The cars shown as being in storage, the statement says, are being numbered by the car works and placed in service at the rate of 250 to 275 per day. The railroad shops have been called upon to assist in numbering such cars and this will increase the daily number of such cars placed in service hereafter.

The cars shown as yet to be built are being built and placed in service at the rate of 75 per day, so that from 325 to 350 cars of this class are being put into service daily.

The composite gondolas are being delayed because two of the large plants have been on strike for the last month and consequently are turning out very few.

Two plants are building 70-ton low-side cars. One is now on strike.

Interesting Application of Heat.—The General Electric Review describes a method of heat shrinking for fitting parts of electrical machines on to their shafts which overcomes various difficulties experienced with press fittings. Water or steam heating is used for flywheels and couplings, while for armatures and field systems conveniently situated heating resistances answer the requirements. In the case of a large armature, the shaft was 35 in. in diameter. Cold pressing would have required a maximum pressure of 600 tons. By heating the armature to about 80 deg. C., however, the shaft could be pulled into the armature with a five-ton chain hoist.

MODERN METHODS OF PAINTING CARS

At the forty-eighth convention of the Master Car and Locomotive Painters' Association held at the Hotel La Salle, Chicago, September 9-11, the subject of painting was covered by a number of excellent papers and considerable discussion on the part of the delegates. We give below two of the papers presented at this convention, entitled "Preservation of Roofs on Passenger Cars" and "The Advantage of Using Pure Paints and More Time in Painting Steel Equipment." A report of other papers and the proceedings of the convention will be found in another section of this issue.

PRESERVATION OF PASSENGER CAR ROOFS

BY J. J. McNAMARA
Painter Foreman, Baltimore & Ohio, Western Lines

The steel roofs and decks of passenger equipment cars seem to present a vexing question, and correctly so when we consider the loss in metal from corrosion. It would seem that they will continue to be a source of worry until it is generally realized that the steel roof must be protected with paint coatings in a manner as good as the body of the car.

This operation, to my mind, should begin at the factory where the steel sheets should be sand-blasted lightly, heated and primed, while yet hot or before contraction has entirely set in. I am satisfied we can get better results in this way, than by priming the sheets when cold, on account of the absence of moisture on the surface and the primer setting up much more quickly, thereby shutting out moisture and gases, which are apt to cause corrosion.

I do not think it advisable to condemn the steel roof on passenger cars without giving it a fair trial, and this, to my mind, it has not gotten. It should be treated in the aforesaid manner and properly applied, with either strap or lap riveted seams, imbedded in red lead putty. At least three good coats of elastic paint should be applied at the time of application and the bow should be sanded. Thereafter once every twelve months it should be cleaned and touched up, applying according to condition, one or two good coats of elastic paint and sanding the bow. If this is done we will not hear so much about corrosion on passenger car steel roofs. If it becomes absolutely necessary to have this work done at terminal points it should be done by or under the supervision of a practical painter, and not left to the care of inexperienced terminal employees.

We cannot expect to get good results if we continue to paint steel roofs in the same slip-shod manner as in the past. I would suggest taking up with our superior officers and our purchasing department and showing them the necessity for purchasing good material for this class of work and having it applied in a first class manner. If this is done we are going a long way towards protecting passenger car steel roofs from corrosion.

Untreated canvas of proper weight, preferably No. 6, makes a very good and serviceable roof for a wood car, if applied on a surface free from sharp edges. To this three heavy coats of lead and oil paint should be applied. The treated No. 8 canvas, however, cannot be depended upon for roof covering, and I cannot recommend it.

(Mr. McNamara submitted specimen plates to show the results secured by the method of painting which he advocated.)

DISCUSSION

H. H. Morgan (C. of Ga.), in a paper on this subject, stated that the practice on the Central of Georgia is to employ a handy man at each of the larger terminal points whose duty it is to carefully inspect the roofs and wherever one shows signs of wear to paint it immediately. This method keeps the roofs protected with live paint at all times and has proven very successful. Out of sixty-seven steel cars in operation only one has come into the shop with the roof in bad condition, and that car was used in joint through service, running between terminals of other roads. Arrangements have been made to meet this condition by occasionally substituting other cars in the through trains for a sufficient length of time to make it possible to thoroughly inspect the regular equipment and do whatever work is necessary to put it in good condition.

There was considerable difference of opinion as to the advisability of sanding the bow at the end of the roof. B. E. Miller (D. L. & W.) stated that sand was detrimental to the paint. H. M. Butts (N. Y. C.) also considered sanding this surface bad practice, as it causes the paint to peel off in large patches. H. M. Butts and E. L. Younger (Mo. Pac.) advocated the use of sand on the ends of the car. J. W. Gibbons (A. T. & S. F.) expressed the opinion that the results depend largely on the atmospheric conditions, and if enough coats are used under the sand moisture will not work through and start corrosion. J. Sherrin (Penn. Lines) considered repainting every six months practical and economical.

THE ADVANTAGE OF USING PURE PAINTS AND MORE TIME IN PAINTING

BY W. BAILEY
Boston & Maine, Concord, N. H.

Paint should be applied to freight cars with a brush and with as much care as on any other surface. Any well known pigment mixed with linseed oil is the only commercial article worthy of the name of pure paint. Unsatisfactory painting can easily be traced to the use of poor paint and unskilled painting, such as spraying process.

Most of the commercial point used today is a poor article compared with good linseed oil paint. Paint mixed with japan and a thinner when applied dries by evaporation and is consequently non-elastic and almost worthless for durability. On the other hand, a paint, the vehicle of which is linseed oil, dries by the absorption of oxygen and is much thicker when dry due to the amount of oxygen taken up in drying. It is elastic a long time and will resist atmospheric exposures longer than any other vehicle and consequently wear longer than any paint mixed with driers and thinners. Japan, or thinners, should not be used in any paint for outside surfaces and exposure. Nothing but boiled linseed oil should be used for a drier. I am a firm believer in the necessity of the sand-blast process for removing rust and scale, as the smoother the surface the longer the paint will wear.

One thing I am in doubt about, and that is, what is the best primer for steel, lampblack, graphite, white or red lead. I do not believe a paint containing a large percentage of oxide of iron should be used as a primer.

PAINTING SHOULD NOT BE RUSHED

A new car should have at least three coats of paint and ten days' time for painting, if one wants an economical job of painting. When cars are turned out with two coats of commercial paint in a few months 10 to 50 per cent of the surface is a mass of rust and scale. The car is seldom returned to the shops except for repairs, and then the same process is repeated. This is expensive. On the other hand, if a good, economical job is desired the car should be given a coat of lead primer and finished with two coats of paint.

If freight equipment could be shopped as regularly as passenger cars, and I think it just as essential, it would be a great saving to the railroads. As it is they are seldom sent to the shop until something needs repairs, and then the rush comes when in the hands of the painter. Passenger cars are shopped every year, principally for appearance sake, and if freight equipment could be shopped as regularly for protection it would be a great saving.

I think it is a right a painter owes to his own reputation as well as a duty he owes to his company to say all the good things he can of good paint and condemn poor paints. To get good paint you must mix it yourself. Twenty years ago mineral was used without grinding and gave better results than the present commercial prepared paints. Mineral, lampblack and graphite can all be used without grinding. Too much cannot be said in favor of linseed oil as a vehicle for paint. It is one of the few vegetable, fatty oils that dries by absorption of oxygen.

To conclude, it should be said that whenever railroads will take time enough to paint steel equipment with the right materials, and in a way that it should be done, then the work will stand, and in the long run economy will be the sure result. The steel coal cars one sees on every hand today are horrible examples of the poor judgment and haste that has been practiced in the painting of this equipment where it has been turned out of the car manufactories. There is no cure for it now but to sand-blast it off and paint it as it should be with right materials and practices. A stitch in time would have saved nine when the cars were built, but the nine stitches should be taken now to save the equipment before it rusts out completely, for there is nothing that deteriorates faster than steel unprotected with a suitable coating.

DISCUSSION

In discussing the materials used for pigments one member told of tests of paint made by mixing the mud from storage batteries with raw linseed oil. After two years' exposure it showed up well.

Portable Oxy-acetylene Welding Apparatus.—In order to facilitate women's work in the repair shops of the Orleans Railway at Paris, a practical portable oxy-acetylene welding apparatus has been introduced. It consists of the usual cylinder of oxygen, filled under a pressure of 10 kilos, and the acetylene reservoir, these being mounted on a two-wheel wagon which can be easily moved from place to place even by a young girl. Flexible tubes several yards long connect the gases with the blowpipe, which is provided with the customary safety arrangement. It has been found that with this apparatus a woman worker is able to do a multitude of small soldering jobs with great rapidity and a minimum of fatigue.—*Scientific American.*

Photo Copyright by Underwood & Underwood, N. Y.

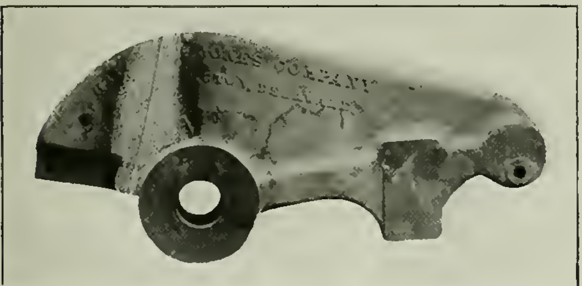
The Port of Georgetown in the Straits Settlements

SHOP PRACTICE

LARGE OXY-ACETYLENE WELD IN PENNSYLVANIA SHOPS

BY J. F. CHANDLER
Supervisor, in Charge of Maintenance of Way, Reclamation and Welding, Pennsylvania Railroad

It is not often that the oxy-acetylene welder is called upon to exercise his skill and ingenuity to the extent of welding together two pieces of metal presenting a broken surface of 330 square inches, and there are those who loudly proclaim that a piece of work of such magnitude is beyond the realm of possibility. Hence, a description of the work accomplished so successfully at the Trenton, N. J., shops of the Pennsylvania Railroad, is of more than passing interest.



The Shear Blade After Welding; Line of Fracture Shown on Surface of Weld

Through the lack of care of a yard employee, engaged in cutting up old metal, a piece of 1¼-in. by 4-in. steel was fed into a shearing machine in such a way that a bolt in the metal broke off the shear blade at the heel of the knife. This was caused by the twisting strain presented when the bolt was caught between the shear blades. The broken face was 33 in. in height, 13 in. in thickness at the bottom and 7 in. at the top. An examination of the broken parts showed the metal to be of the highest quality of cast iron, there being no flaws or sand holes, showing that the break was due entirely to misuse. The shear has capacity for cutting 3½-in. round bars, 3¼-in. flat bars, or 10-in. by 1½-in. flat bars, and is as large as cutting machines of this type are usually made.

Immediate repair became a very urgent problem, as it was impossible to order and secure a new machine under several weeks, if not months, and delay in replacement meant much delay in the making of billets and forgings for engine work, inasmuch as this shear is used almost daily in cutting metal for the large furnace from which billets are secured.

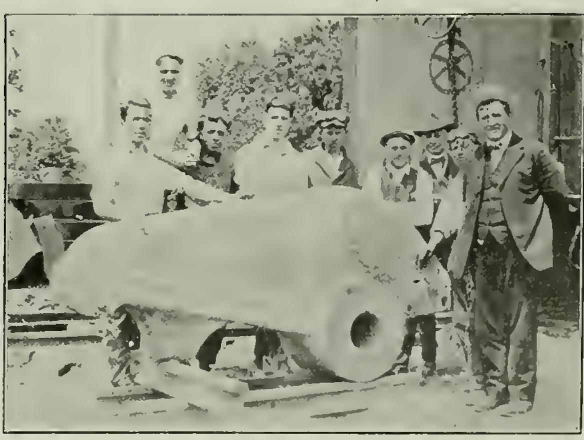
A great deal of work has been done with oxy-acetylene equipment at Trenton, but nothing to compare in size with the case here presented. The question of welding together broken pieces of so large a surface was submitted to an expert who expressed the opinion that the two parts could be welded perfectly.

"Conscientious objectors" and scoffers were all there with their arguments against trying it, not realizing that even if a failure resulted, we would be no worse off than with a broken shear, except for the expense entailed in the attempt. The matter of repairing was finally decided, and permission was given to do the work.

The broken parts were taken to the machine shop and the metal was planed away at an angle of 45 deg. from both sides of each piece, on one side to 65 per cent of the thickness and to 35 per cent on the other, so that when the two parts were brought together, lying on their sides, an edge only about ¼ in. thick remained. This was left as an aid in setting the parts for preheating and welding, and for the purpose of preserving the exact length of the shear blade. This work required two days, after which time the parts were ready for preheating.

The broken parts were laid flat, set accurately and firmly secured. A fire brick furnace was built around them and a charcoal fire started. After eight hours of preheating, the temperature was at the proper point to commence welding.

The deeper cutting, the 65 per cent side, was welded first. Oxweld cast iron alloy rods of ¼-in. and ⅜-in. diameter were fused in from the bottom up and outward from the middle of the cutting. Ferro flux was used in this work, being constantly added to insure fusion of the metal.



The Repaired Blade and the Men Who Did the Work

After it had been filled and slightly re-enforced to prevent fracture in handling the casting was turned over and the other side welded up in the same manner. It will be noted from the illustrations that the cavity to be filled was of an astonishing size.

Six welders were assigned to the work, and were worked in relays of two each, using four Oxweld outfits with No. 15 welding heads. The extra number of men was necessary because of the intense heat generated, not only by the torches but by such a large mass of iron on a large charcoal fire. In fact, the heat was so great that those using the torches protected their faces with asbestos masks, and it was frequently necessary to dip their gloved hands into water to cool them. Compressed air also was used to blow the hot air away from the men at work.

The men engaged in the work were enthusiastic as to its success, and knowing they were engaged in a most extraordinary undertaking, were exceedingly careful to see that nothing untoward should happen to endanger the success of their efforts, nor that any lack of attention should militate against the desired end.

There were used in the repair of this shear:

Oxweld cast iron alloy rod	445 lb.
Oxweld ferro flux	12 lb.
Acetylene	6,116 cu. ft.
Oxygen	7,640 cu. ft.
Labor at 68 cents, in both pre-heating and welding	203 hours
Charcoal	100 bushels
Coke	20 bushels

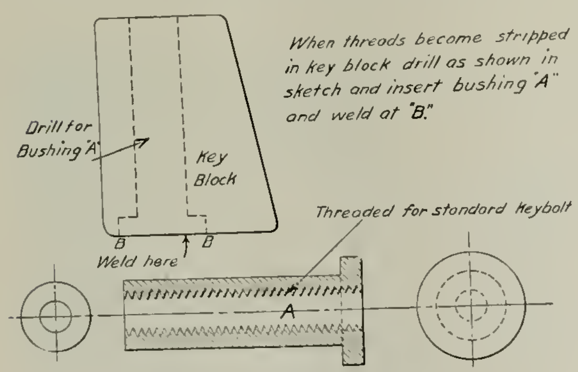
The total cost of making the repair was about $400. The cost of a new shear blade is variously estimated at from $1,500 to $1,700, so that the saving by welding approximated $1,200, to say nothing of the loss by being deprived of the use of this machine.

The shear has been fully tested and is doing business as usual. It appears to be as good as new.

IMPROVED KEY BLOCK FOR MAIN RODS

BY J. H. HAHN

An improved key block for the front ends of main rods is shown in the sketch. Considerable trouble is often experienced with the ordinary design of key block, due to the stripping of the threads, which usually necessitates a new key block. With this improved type of key block, however, when the thread strips, it is only necessary to remove the bushing *A* and replace it with a new one. When the threads in a key block of the ordinary type become stripped, it can easily be converted to the improved design by drilling it out



The Improved Key Block and Bushing

and welding in the bushing *A*, as illustrated. These bushings can be made cheaply on a turret lathe and carried in stock ready for use, and are easily and quickly inserted, thus facilitating the despatch of an engine from the roundhouse and also effecting a considerable saving in the cost of both material and labor.

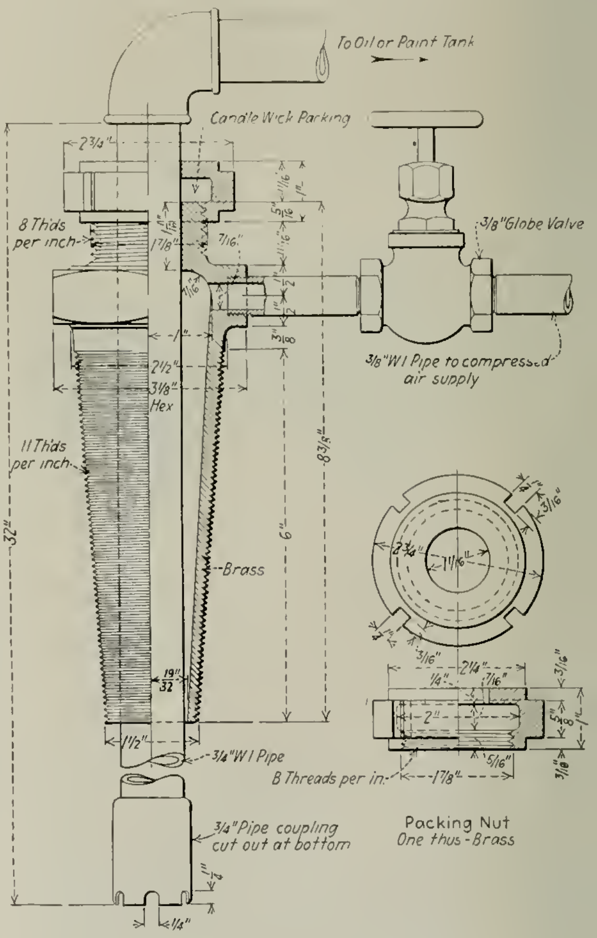
Railway Rolling Stock in France.—During 1913 France produced 700 locomotives, 2,000 passenger cars and 18,000 freight cars. Before the war it was necessary to import rolling stock, but today it is expected that after the equipment plants in the North are reconstructed, France will be able to export both cars and locomotives after the present requirements of 1,000 locomotives, 2,600 passenger cars and 24,000 freight cars are provided. In 1913, France imported railway rolling stock to the value of 23,000,000 francs and exported 7,000,000 francs.—*Le Génie Civil.*

REMOVING LIQUIDS FROM BARRELS OR OTHER CONTAINERS

BY NORMAN McLEOD

A means of removing oil or other liquids from barrels or any closed container is shown in the drawing. This device consists of a ¾-in. pipe inserted through a tapered metal plug, which is threaded to screw into the bung-hole of the container.

The plug is a hollow shell for the greater portion of its length and a hole is drilled and tapped through the side to receive a ⅜-in. air connection which is fitted with a globe valve to control the air pressure. A number of apertures are cut in the lower end of the outlet pipe so that the pipe

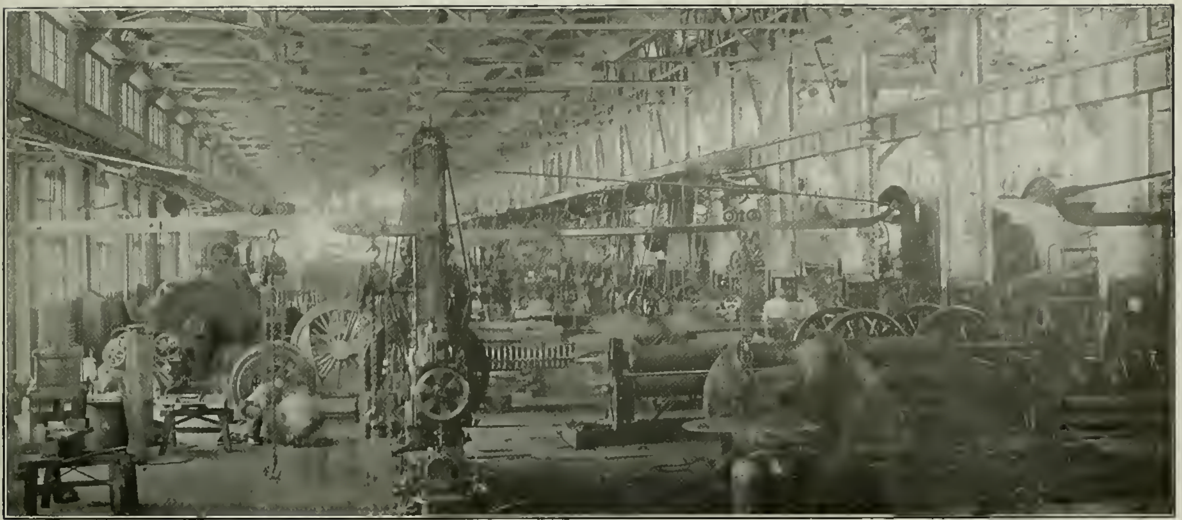


Assembled Plug, Valve and Piping

may rest on the bottom of the container without stopping the flow of liquid.

To remove a liquid from a container the device is inserted and air pressure applied through the air connection, thus forcing the liquid through the outlet pipe. This pipe may be curved at the top so that the liquid may readily flow into any portable vessel or may be connected directly to the tank or any other receptacle into which it is desired to transfer the liquid.

This method has proved very successful in railroad oil houses.



D. L. & W. Locomotive Shops at Scranton, Pa.

General Foremen's Convention

Papers on Accident Prevention in Shops and Enginehouses, and the Welding of Locomotive Cylinders

THE fifteenth convention of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, on Sept. 2-5 with a large attendance representing all sections of the country. During the four days' sessions papers dealing with some of the important technical problems in connection with the repairing of locomotives and cars were presented and in addition labor conditions were discussed informally. The convention was opened with an invocation by Bishop Nicholson. The report of the secretary-treasurer was then read which showed the total membership to be 221, and the balance in the treasury $752.

ADDRESS OF R. H. AISHTON

R. H. Aishton, regional director of the Northwestern Region, spoke on the present railroad situation. Mr. Aishton emphasized the importance of securing increased production in all industries and quoted a letter from Walker D. Hines in which the director-general stated that in his opinion less progress had been made in securing increased efficiency in maintenance of equipment than in any other department. The higher railroad officers, Mr. Aishton said, come in contact with the actual operation of the roads only through statistics and because of that fact it is important that the foreman should be competent and progressive in determining the policies in his own department. He endorsed the proposal to put an end to wage controversies and restore more nearly normal conditions, characterizing this policy as necessary from a patriotic standpoint to keep America from falling behind in the contest for world trade.

ADDRESS OF PRESIDENT L. A. NORTH

Following Mr. Aishton's speech L. A. North, superintendent of shops of the Illinois Central, and president of the association, delivered an address. Mr. North spoke in part as follows: The General Foremen's Association was formed primarily for educational purposes only. Our intent and purpose is to furnish a channel for the full, free flow of ideas pertaining to the best mechanical practices and from this stream of experience to add to our store of knowledge. The greater the demand upon the transportation system of the United States, the greater is the responsibility of those charged with its maintenance. This association must be made one of the potent forces in the progress of transportation. During the war period many appeals were made to us to further the common cause of our country. In my opinion, the present crisis of the nation is just as acute. Let us, therefore, rise to the issue and meet it in a loyal and determined spirit and go home from this convention with a high resolve to do our utmost toward strengthening our nation's facilities.

At the conclusion of President North's address W. W. Scott made a short response in which he dwelt on the difficulties which supervising officers experience under present conditions. He stated that in his opinion the efficiency of shops and roundhouses had decreased 50 per cent in the past five years.

ACCIDENT PREVENTION IN SHOPS AND ENGINEHOUSES

The Wednesday session of the convention was devoted to a discussion of methods of preventing injuries. R. C. Richards, claim agent of the Chicago & North Western, made an address in which he reviewed the results of the safety work conducted during the past nine years on the Chicago & North Western. Several papers outlining methods adopted in safety work were read, some of which are abstracted below:

SAFETY FIRST

BY B. F. HARRIS
General Foreman, Southern Pacific, Oakland, Cal.

To generate and maintain a living interest in the movement to protect life and preserve the body from injury, we must face a difficulty that may be relieved by one or more of the following measures: (1) Imposing penalties for gross negligence. (2) Awarding premiums for creditable records. (3) Publishing the names of persons injured. (4) Publishing an honor roll of those who have been uninjured during the month.

Negligence may be generally divided into two classes: Neglect of the injured and neglect contributed by one or more who created the condition causing the accident, or who had guilty knowledge that such condition existed. As any penalty, however mild, may cause resentment and produce an interest that might detract from, rather than contribute to, the effectiveness of Safety First, the most convincing evidence should be required before inflicting a penalty on any party. It should then be tempered with due moderation, should it be imposed on the injured person. Mathematically stated: The punishment suffered from the accident should be subtracted from the penalty that would be due to an uninjured, or second party, who had caused it. This is a period of broken precedents, it follows that a proposal to award premiums to encourage creditable caution, productive of records free from accounts of accidents, will not be met with surprise, but may be thought possible.

Many simple rewards may be given, among them the following:

(1) Cancellation of discredit for former accidents.

(2) Creation of new credits.

(3) Issuance of an annual pass for the best record in each department on every division, (a full year's record included).

(4) A vacation on pay.

The suggestions of four classes of awards should be sufficient to start this phase of Safety First growing.

When a person's name is published as the principal in an accident, there is a condition of mind produced among large bodies of men to discourage all forms of negligence and foolhardiness. Every person of good health and average understanding has enough self pride to avoid public exposure of their identity with accidents. The interest excited by exposure is not pleasant but results are usually forthcoming.

Appreciation is one of the natural cravings of every human mind. The most effective application of the principle is to publicly acknoweldge the caution of employees, at each division point, shop, or yard, by posting an honor roll, each month, of all persons who have passed through the preceding month without being a party to an injury. Although it should not be expected that there will be a marked rivalry to keep one's own name on an honor roll we may well know that the acknowledgment of continued caution on the part of workmen will prevent resentment from those who are sensitive when their efforts are not recognized. A trial of these four measures as outlined will soon demonstrate their value as a means of reducing injuries to a minimum and the advantages to be gained are worth all that it is likely to cost.

SAFETY FIRST IN SHOP AND ENGINEHOUSE SERVICE

BY W. T. GALE
General Foreman, Chicago & North Western, Chicago, Ill.

New lines of thought and action, with Safety First as the slogan, should be ever welcome to all, more especially to those who may have suffered directly or indirectly from the carelessness or thoughtlessness of others. Safety First, when carried to its proper issue, bespeaks life and happiness in its best phases. On the other hand, the cold indifference and selfishness of some, make for suffering for others. The criminally careless, and those who neglect to have a proper care for the safety of others, merit just scorn and severe censure from those to whom they are responsible. Selfishness and carelessness make for discomfort and misery to others.

L. A. North (I. C.)
President

W. T. Gale (C. & N. W.)
First Vice-President

J. B. Wright (H. V.)
Second Vice-President

The results of the safety movement on the Chicago & North Western have been highly gratifying. The shop committees hold semi-monthly meetings, after making inspection of the various departments. At these meetings reports are made of the unsafe condition of tools, machinery, etc., and recommendations covering the same.

These local committees have accomplished most excellent results in shops and roundhouse service; all machines with gears or other working parts exposed and considered a menace to the safety of the operator have received attention and the danger, if any, averted. Line shaft couplings have sheet iron covers, the dangerous setscrew has been abolished, men have been protected from falling belts, all of which make for safety. Glass windows have been placed in all communicating doors between the various shops, in order that employees who are carrying dangerous implements in their hand, or on their shoulders can see and thus avoid injuries. Emery grinders have sheet iron guards around the wheels, and an adjustable frame with glass in it is attached to wheel guard which allows operators to grind tools without getting the flying particles of emery in their eyes, a round smooth iron cup is placed over the end of the emery wheel mandrel nut, preventing employees' working jackets from being caught upon the end of the revolving shaft. Danger sign posts are placed in proper positions in shops when repairs are being made overhead, employees' working tools, such as hammers, chisels, driving mandrels, etc., are examined by the foreman and the safety committee for cracks or breaks, and sharp splintered edges, and when found are replaced by new or repaired ones. Broken and rotted floors are kept in repair, automatic bells and gongs are placed on all transfer tables and moving cranes, air warning whistles for overhead cranes are a feature, the man who oils overhead machinery is supplied with a strong metal warning whistle, in order that the operators of machines below will not start up machinery.

Floor motors in shops have 1 in. pipe guard rails placed around them, open fuses have been replaced by N. E. C. cartridge fuses, all open switches have been enclosed in steel cabinets with spring hinged doors, the replacing of all fuses is done by an electrician only, motors and generator frames have been permanently grounded to avoid accidents by shorts, open wiring has been replaced by conduit and lead cables, all line shaft motors have been equipped with safety stop control buttons, all drop light cords over machines are being removed, and replaced by individual cords, vapor proof lamps have been installed in oil houses and acetylene store houses. Electricians remove main line fuses when going above to do repair work on cranes, especially from automatic floor operated cranes. Crane men are not allowed to keep anything on the crane floor with the exception of grease and waste, safety ropes are attached to cranes for descending in emergency. All employees are required to use and are furnished glass goggles for dangerous work. A large wooden platform fitting over the top of the boiler for grinding in stand pipes is a safe contrivance for men doing this work.

Hoisting chains and wire cable are regularly examined for flaws, lights have been put in dark places and roofs ventilated when necessary. Strong iron cans are used to hold scrap paper and waste during the day, the same being taken out of the shop at night. There are local fire alarm boxes in every shop, water hose pipes and hydrants in and out of the shops, an efficient fire fighting company, a doctor upon the shop grounds with able assistants to care for emergency cases. In engine house service, firing-up wood is not put into the cab until it is time to fire up the engine on account of men working in the cab and danger from nails in wood. Men have been instructed in the use of the blow-down pipe to see that it is laid flat upon the floor, and that connections are properly made so that there will be no danger of the pipe blowing off under pressure, etc., all of which shows that safety first is not a question of dollars and cents, but a question of saving human life, the most valuable thing in the world.

G. H. Logan (C. & N. W.)
Third Vice-President

H. E. Warner (N. Y. C.)
Fourth Vice-President

W. F. Hall
Secretary-Treasurer

ELIMINATING EYE INJURIES

BY L. A. NORTH

Superintendent of Shops, Illinois Central, Burnside, Ill.

One of our greatest obstacles in the Safety First movement has been in getting the employees to wear the goggles which the company have furnished to properly protect their eyes. Comment was received at the start on account of fear of eye infection. This was overcome by constructing a sterilizer so that when the goggles were returned to the toolroom, being given out to the employee on a check, they were thrown in a bath of wood alcohol, and allowed to remain for a stated length of time, after which they are removed and thoroughly dried. This in a great measure overcame any objections from this source. Then, again, complaint was made that the goggles were too heavy and clouded up during the extreme warm weather. This has been overcome by securing a lighter goggle, and a better ventilated one, so that at the present time we do not experience a great deal of trouble in requesting the employee to wear the goggle and carry out the instructions that have been issued in regard to eye protection. As the eye injuries were numerous throughout the entire plant, this was one matter that required a strenuous campaign to decrease personal injury.

Papers dealing with the safety movement were also presented by C. Coleman (C. & N. W.), J. B. Wright (H. V.), J. W. Womble, W. L. Shaffer and J. Powell.

WELDING OF LOCOMOTIVE CYLINDERS

BY L. A. NORTH

The welding of locomotive cylinders and other parts has been made possible and very successful by the introduction of oxy-acetylene and electric welding. It has been possible to weld locomotive cylinders which formerly would have been scrapped or repaired with either a brass patch or a dovetailed insert of some other metal, the weld in the majority of cases making a substantial and satisfactory job provided the expansion and contraction had been properly taken care of.

Experience has taught us that in order to properly weld a locomotive cylinder, or a casting of any make or design, it is necessary to thoroughly pre-heat to insure a uniform temperature in order to properly take care of the contraction and expansion and to avoid cracking after the weld has been made and the metal has been allowed to cool off. The success of any weld of this kind depends largely on the care used in the pre-heating and the judgment of the operator making the weld. We cannot be too particular in the selection of the operator for this class of work.

Some difficult welds have come to my observation, one in particular, where the entire upper portion of the cylinder at the port-area had been totally destroyed. This was repaired by having a grey iron patch cast in the foundry, fastened to the cylinder by means of clamps and welded in place. The cylinder was pre-heated to a uniform temperature to take care of the expansion and contraction. After the weld had been made and the cylinder had cooled down, a reinforcement was added to this weld by drilling through between the stud holes and securing the additional support by tap bolts which were tapped and screwed into the main barrel.

It is possible to weld broken bridges in slide valve cylinders successfully. Recently this was done and effected a saving of two cylinders in place of the one, which was cracked, as the cylinder which was repaired was an obsolete pattern and had we not been able to make this weld, the application of an entire pair of cylinders to this engine would have been necessary. As this engine was one that in a few years will be placed in the scrap pile, I am satisfied that the weld will outwear the present cylinders.

Not having experience with electric welding on cast iron, I am not prepared to enter into a discussion of this method to any great extent, but I have examined a number of castings which have been repaired with the electric welding process and careful examination failed to disclose any flaw or fault in the weld.

AUTOGENOUS WELDING OF CYLINDERS AND OTHER PARTS

BY J. T. LEACH
General Foreman, Pennsylvania Lines, Wellsville, O.

The welding of cylinders and other castings by the carbo-hydrogen, oxy-acetylene or electric process has made great progress in the last few years. Hardly any discovery or invention has meant so much to the railroads and casting manufacturers as the various methods of welding broken or defective castings.

There was a time when it was necessary to inspect all cylinders on locomotives before they were taken into the shop for classified repairs, in order to know that no new cylinders were required, as the stock of cylinders carried by the stores department was limited, and if a broken cylinder could not be patched and the storekeeper had no casting, the locomotive had to be held awaiting repairs until such time as the material could be procured. This was an expensive arrangement at the best, especially in the last few years when power was so badly needed. With the different methods of welding cast iron, a cylinder may be cracked or broken quite badly, yet it can be repaired successfully. The question arises as to the cost compared with a new cylinder, except in case of a new design where patterns have not been provided by the railroad or a foreign type of locomotive for which it would require several months to get a cylinder.

In making electric welds, in case the cylinder is only cracked, it is first necessary to pull the cylinder back in place, as nearly as possible, by the use of a rod and clamp. If this will not do the rod should be heated and the cylinder pulled up in that manner. The entire surface should be cut cut V-shaped at an angle of from 45 to 55 degrees and then drilled and tapped on both sides of the crack for ⅝ in. to ¾ in. studs. These studs should be staggered, that is, one row to be drilled down on the bend and the other staggered in the flat portion of the cylinder. The studs should be screwed in the cylinder ⅝ in. or ¾ in. and then cut off about ¼ in. from the casting. All dirt should be cleaned from the portion to be welded before starting the welding. This welding should be done at a slow rate of speed in order to keep the cast iron cylinder from becoming heated. In welding the cylinder the ordinary grade of Swiss welding rods of ⅜ in. or 5/32 in. diameter should be used. It is not necessary to remove the bushing or do any pre-heating to get a satisfactory weld, although if this is done a much better weld would be the result.

The cost of an acetylene weld is from $50 to $175 for an ordinary weld. This is an average figure, for the jobs vary so much in size and time that it is hard to arrive at a true average, however, the saving in any case amounts to several hundred dollars.

The method of welding by the oxy-acetylene process is as follows: The cracked portion should be cut out V-shaped at an angle of about 60 degrees. If the broken or cracked portion is bulged out, a rod and clamp should be used to pull it up as nearly to the original position as possible. The dirt should be cleaned from the area to be welded. Then a furnace of brick should be built around the cylinder and by means of a charcoal fire or blow torch the cylinder should be heated to a cherry red. In some places an acetylene torch is used for pre-heating the cylinder, but that is expensive.

After the cylinder has been pre-heated to the required heat welding should be begun, always maintaining the charcoal fire so the cylinder will have a uniform heat. In welding special silicon cast iron sticks are used and if this is not available a good grade of air pump rings will answer. The welding of the cylinder should be continuous, and if it is a large break, one operator should relieve the other. This keeps the casting at a uniform heat. If the casting is allowed to cool, the weld will crack. The charcoal or blow torch fire should be kept up for several hours after the weld has been completed and then allowed to die out.

Acetylene welds cost considerably more than welds made by the electric process, but this is often due in part to the lack of experience of the operator and also to the method followed. The experience I have had with carbo-hydrogen has been limited to cutting mostly, but it is possible to get the same result from it in welding cast iron.

Other papers on the subject of autogenous welding were also prepared by W. Gale (C. & N. W.), B. F. Harris (Sou. Pac.), J. H. Frizell (A. T. & S. F.), J. W. Womble and J. Powell.

DISCUSSION

C. D. Walker (Great Northern) advocated banding and bushing cracked cylinders on the ground that the cost of doing the work by that method was lower than when autogenous welding processes were used. Several other members concurred in this opinion, although the majority preferred to weld longitudinal cracks even though the defect could be corrected by the use of clamps or bands. J. M. Horne (M. & St. L.) stated that good results had been secured by using brass wire for cylinder welding, but this method was not generally favored due to the high cost of the wire. M. H. Westbrook (Gd. Trunk) described methods used for burning out bushings by the use of a carbon electrode. He also stated that by using sulphur on the weld the added metal was made soft so that it could be machined readily. Mr. Westbrook gave average figures for the cost of welding as follows: Oxy-acetylene process, $3.00 per hour; electric welding process, .90 per hour.

OTHER BUSINESS

Several papers on the design and maintenance of draft gear were read and discussed, an account of which will be found in Car Department of this issue.

During the convention the question of admitting supervising officers of the car department to the association was considered and the by-laws were amended to make general foremen of the car department eligible for membership. On Thursday V. R. Hawthorne, secretary of the Mechanical Section of the American Railroad Association, outlined the organization under which it was proposed to have the General Foremen's Association affiliate with the American Railroad Association as a division of the Mechanical Section. A committee was appointed to consider and report upon this matter. The following officers were elected: President, W. T. Gale, machine foreman, Chicago & North Western; first vice-president, A. B. Wright, general foreman, Hocking Valley; second vice-president, G. H. Logan, general foreman, Chicago & North Western; third vice-president, H. E. Warner, superintendent shop, New York Central; fourth vice-president, T. J. Mullin, general foreman shop, Lake Erie & Western; secretary-treasurer, William Hall, directing foreman, Chicago & North Western; chairman, executive committee, C. A. Barnes, general foreman, Belt Railway of Chicago.

Convention of Master Painters

Association Amalgamates With A. R. A.; Papers on Standardization and Linseed Oil Substitutes

IMPORTANT changes in the organization of the association and action designed to bring about more satisfactory methods of purchasing paint and varnish were the outstanding features of the forty-eighth convention of the Master Car and Locomotive Painters' Association which was held at the Hotel La Salle, Chicago, September 9-11. For some time past the officers had had under consideration the proposal to amalgamate with the American Railroad Association as a division of the Mechanical Section. This matter was brought before the convention and after considerable discussion the members present by unanimous vote decided to merge with the parent organization, thus becoming a division of Section III, Mechanical.

The first convention session was opened with prayer, following which an address of welcome was delivered by a representative of the Chicago Association of Commerce. J. S. Gearhart, president of the association, then delivered an address in which he reviewed the organization's activities during the past three years and outlined the proposed amalgamation with the American Railroad Association. The convention then proceeded to take up the discussion of the technical papers prepared by the members, which are abstracted below.

WHAT STANDARDIZATION OF PAINTING RAILWAY EQUIPMENT IS NECESSARY?

Two papers were presented on this subject, one by W. O. Quest, master painter of the Pittsburgh & Lake Erie, McKee's Rocks, Pa., and the other by W. A. Buchanan, foreman painter, Delaware, Lackawanna & Western, East Buffalo, N. Y.

PAPER BY W. O. QUEST

At the present hour, the most necessary and essential paint shop standardization would be some practical method of satisfying labor on the matter of wages in the painting of equipment. Will it be possible to standardize the labor operations of the railway car paint shops now under government control? As something of an optimist, strong in the faith that the American workman will soon realize that to bring order out of a threatened social upheaval, he must turn back to the old-time ideas of soberness and thrift, I do believe that it can be, will be, and must be done. But how such desired standardization is to be brought about, is open for the suggestive powers of just such an assembly as this. I believe that it can be happily brought about, if an amicable live and let live arrangement is made in the spirit of fair dealing between the railway organizations as employers and the employees.

PIECE WORK SYSTEM ADVOCATED

The labor of painting cars and locomotives, etc., could be standardized by the adoption of a universal piece price system, the wage paying system that we firmly believe in as the most equitable to employ any kind of labor, the most equitable for all interests, notwithstanding the fact that modern labor federations in recent years have been instrumental in entirely abolishing this method of employing labor in the American railway shop systems. In my opinion, a fair scheduled piece price system is the only method whereby labor can give a fair equivalent for wages paid. Such a proposed piece price schedule, to be standardized, should be job named and not numbered. The unit or fixed prices should be open to shop inspection at all times and never officially juggled in the event of the more skilled labor earning more pay when called upon to help out in a shop rushed for output. If a piece price labor standardization can be put into action, the prices should be so scheduled that the earnings of a first class skilled worker in a railway car paint shop would equal the earning rate of the outside general trade skilled worker. The original schedule of prices should be carefully figured out and classified, each job continuously named regardless of name repetition in the several classifications. The original job prices as scheduled should never be price changed, as we have found it to be no easy matter for the men to follow up such change and it was sure to create dissatisfaction.

When found necessary to advance or lower the wage scale, an up and down percentage method should be used.

STANDARDIZATION OF MATERIALS

Next to the labor problem, the most important issue would be that of specifying the standardization of paint supplies, as there cannot be any fixed material standardization without manufacturing, purchasing, chemical and application specifications. The paint and varnish maker will be called upon to furnish certain standards of car shop specialty material on fixed paint making formulas, that must be lived up to. Something represented as just as good or better at a lower price, unless first tested by some prescribed authority, cannot be consistently introduced without upsetting the primary law that demands standardized materials. Possibly in many instances this material is theoretically or authoritatively formulated from raw paint stock listed on the open market, which is often unsuitable or perhaps ruinously mixed by people who are trying to meet competition in the paint business, but do not know the special requirements of the railway paint shop.

There are no suggestions that will safely promote a material standardization in the railway paint shop, if the purchasing departments continue to buy paint stock on price regardless of known quality or the paint-making reputation of the selling concerns. Companies have in the past and still will in the future break into the railway paint field, without knowing that such paint is a specialty and is especially applied.

If any such suggested railway paint standardization ever becomes a law, the activities of the railway chemical laboratories will be quite strenuous and especially active when they come to the matter of settling the many disputes sure to arise.

METHOD OF APPLICATION IMPORTANT

It is in the application of the paint stock that the master car painter must receive his full recognition. He will have to be put on the standardizing committees with full power to act, as he and he only knows what is necessary to make a good job. If what is termed necessary standardization of certain or all classes of job paint work is adopted, he will as usual be held responsible for the labor and material costs.

I will here offer a list of work items that in my opinion could be readily standardized, if it is found necessary to try the standardization scheme out. If adaptable, locomotive painting should be standardized. The quality of the protective paint and varnish should be the best weather, smoke, acid or grease resisting paint stock that can be found on the market at any price. Every inch of the painted metal surface should be sandblast cleaned. All castings to be painted, should be chipped off smooth and freed of live rust, etc., with the sandblast, as it is a waste of time and money to paint over crusted unremoved grease, mill flash, or live rust of any kind. If the work is standardized, the paint specifications should call for hard, tough, elastic paint stock, as it is a great mistake to apply soft oil paint where it is to come in direct contact with solvent cutting greases and acids, which when deposited on the locomotive's painted surface, can only be removed by heavy erosive cleaning.

The painting of passenger, mail, baggage, and similar cars could be classified as to labor and material. Owing to the sameness of the work the jobs could be readily standardized. When material classifications are being standardized, the many examples of the best paint and varnishing finishing systems which have been successfully used for many years in the railway paint shop should not be forgotten in the standardization arrangements, and the interests of worthy manufacturers should be protected owing to the fact that their specialty products have helped to make car painting history.

UNIFORM STENCILING OF FREIGHT CARS

Based on the past work of this association's efforts to establish standards in freight car painting, especially to standardize the stencil markings, which undoubtedly has been and still is one of the most pronounced wasters of time, labor and material that the railway officials are confronted with, we heartily endorse the idea of standardizing every detail that covers the painting and stencil marking of the railway freight car. In the standardization scheme, the stencil lettering and numbering should be made in the same style and sizes and sent out from a designated manufacturing base in pounce pattern form. If made by skilled stencil makers from established drawings, the stenciled railway freight car would present a neat lettered appearance.

The paint repair costs of the future would be light, owing to the undisputed fact that such a railway freight car stenciling standardization scheme would save thousands of dollars in stencil-making costs for every railway company that will endorse and adopt such standardization.

PAPER BY W. A. BUCHANAN

When locomotives are undergoing heavy repairs, a very careful check should be made of the condition of the paint on cab and tender. If it is found to be blistered or badly fractured and the shopping period will permit, the old surface of the paint should be removed by sandblasting if the steel construction, or any other suitable method. The sandblast is preferable for it not only removes the paint but gives a clean bright surface to again build up a good paint foundation which is very essential on locomotive tanks, where the surrounding elements are so destructive. This is also true of the cab and domes, also the steam chest and drivers.

A well equipped lye vat is almost indispensable for the cleaning of the small parts before painting. Wash tanks, for sash and doors should be installed, equipped with hot and cold water. A good system of stationary scaffolding is found to be a great convenience and time saver, as labor is a factor that cannot be lightly dealt with under the present order of things

METHOD OF PAINTING FOR METAL SURFACES ON LOCOMOTIVES

After the foundation work has been properly prepared a system of surfacing as follows will be found very elastic and durable. The priming coat for steel surfaces should consist of a good elastic primer. After applying it should be allowed to dry at least 48 hours, after which, a second coat consisting of one half primer and one half surfacer, can be applied and allowed to dry for 24 hours. Next all uneven surfaces should be puttied with hard drying lead putty, then the whole surface knifed with No. 3 surfacer or surfacing compound. When sufficiently dry one coat of roughstuff should be applied. If desired, it can be colored and serve as a guide coat, which will save time. This surface can be rubbed the following day.

After being sandpapered the first coat of color should be applied. It has been found a good practice to continue the elastic coatings. If black enamel is to be used the first coat can be reduced one-third with pure turpentine. This method can also be followed in the second coat of enamel. After the lettering and striping is applied two coats of good elastic varnish should be applied. The first coat can be a good quality of rubbing varnish. It should be allowed 12 hours to dry, then a second coat of good elastic finishing varnish should be applied.

Cut-in jobs are treated practically the same excepting sandblasting, and under coatings. With fair usage, surfaces thus built up should last at least five years before again requiring removal of the paint. The engine frames should be thoroughly scraped and cleaned and then painted with one coat of a good quality of frame black. Trucks and tank frames should be treated practically the same, excepting that the outside of the frames should be varnished. The interior of tank frames should be painted with two coats of a good oil black, when new or when decks are removed when undergoing general repairs. Jackets and all upper work usually can be protected with one coat of a good quality of black enamel.

The interior of the cab, including all pipe work, after being thoroughly cleaned and touched up, should receive one coat of enamel of any shade desired. Cab roofs, if of steel construction, should be thoroughly painted with some good quality of steel car paint. The coal spaces and decks of tenders must be carefully cared for as the elements they carry are very destructive to steel plates if not well protected with paint.

PAINTING AND STENCILING FREIGHT CARS

The painting of freight cars has become more essential at present than at any other time since the building of this class of equipment. This is due to the fact that steel is fast replacing wood in their construction. Greater care must be exercised in their upkeep for the life of steel is rather brief if not carefully watched and kept painted.

When cars are new or rebuilt it is very essential, especially on steel cars, to thoroughly clean and paint all laps. Red lead has been found to be the best material for this purpose.

J. Gearhart (Pa.)
President

J. W. Gibbons (A. T. & S. F.)
First Vice-President

A. P. Dane (B. & M.)
Secretary-Treasurer

Freight car bodies of wood construction should be coated with a good metallic paint underneath all corner irons, or plates before they are applied. This also applies to running boards before they are applied.

After cars are ready for painting the priming coat should be applied as soon as possible. A mixture of one part pigment (if metallic semi-paste, ground in oil) to three parts vehicle has proved very satisfactory for this purpose. Additional coats can be followed up each day under favorable climatic conditions.

The stenciling is next in order and should consist of a good plain readable letter or numeral, either of Roman or Egyptian style. Insofar as possible, a uniform practice of grouping the information should prevail on all roads. Master painters will readily see the advantage to be derived in the saving of time and expense, if such an arrangement existed. No class of car men would appreciate it more than the car inspector and yard men who are obliged to get their information very often from the sides of cars and very many times under the most adverse conditions. We would, therefore, recommend that a standard distribution of stenciling for box cars be as follows:

The initials or name of the road together with the number of the car should be placed to the left of the door. The lower markings should include the capacity of the car, the cubical measurements, the date built, the class, date and where last painted, and also the weight of the car and the safety appliance markings. Any special information such as when boxes were last packed should also be placed in this group. All the information a car inspector requires to handle this phase of his duties with despatch are thus placed in one group. To the right of the door can be placed the information showing the class of commodities the car was designed to carry. The lower markings on this side of the door should show the length, height, and width of the car.

On the end of the car should be shown the initials of the road and the number of the car, placed to the right of the brake wheel. The lower marking should consist of the following information: the kind of triple valves the car is equipped with, the kind and size of coupler shank, the kind of draft rigging and brake beams (No. 1 or No. 2). The doors of the car should be stenciled on the inside only, and should show the initial of the road and the number of the car.

Air brake equipment should at all times be kept painted and stenciled showing when last cleaned and where done. When selecting cars for repainting this information should be taken and booked, for if found to be in date, it must be replaced on the cylinder of equipment. The omission of properly maintaining this information is a reportable defect. The stenciling of trucks showing the name of the road and the number of the car the truck belongs to is essential. When cleaning up wrecks or derailment of cars, unless this information can be gathered the sorting out of the right trucks is almost impossible, for in many cases the car body has been completely destroyed.

PREPARING STEEL CARS FOR PAINTING

The painting of steel car equipment should be very carefully watched. The first coatings on new steel cars are very often done with too little regard as to the preparation of the plates before the paint is applied. All dust or flash scale should be removed if possible for unless this is done paint will not adhere to the steel very long and work that should wear at least three years is in bad condition after one year.

If possible, sandblasting is the best method of preparing steel plates for initial coatings. However, should this means of cleaning be unattainable, then we must resort to the book scrapers after which dusting with a steel wire brush is resorted to. This serves the purpose very well for removing rust formations, but will not remove the flash scale. Coatings for steel hopper and steel gondola cars should consist of a good carbon pigment ground in oil and mixed to meet prevailing condition. Under no conditions should one coat of paint be expected to protect this class of equipment.

No system of painting could be considered complete without suitable quarters for handling the work with the least possible delay to shopping periods. We would, therefore, recommend that suitable tracks be assigned, either inside or outside of shops, equipped with a good dry air line of 80 or 90 lb. pressure, for the purpose of air dusting cars and spraying the under portions of bodies and trucks. Ample space between tracks is also very desirable.

The stencilling of this class of equipment should be maintained practically the same as on box cars; i. e., kept to the left of the car, or centrally located. The weighing and stencilling of equipment is a very important feature and should be constantly watched, for in selecting cars for repainting, the old light weight is a part of the record. The painter should place this in a book with the other items, necessary for record, concerning the car. This enables him to properly check any material difference in the new as compared with the old weight.

DISCUSSION

H. M. Butts (N. Y. C.) proposed that the association issue a pamphlet of approved practices for painting railway equipment. There was some difference of opinion regarding the relative merit of carbon and lead paint. J. W. Gibbons (A. T. & S. F.) stated that for steel underframes he considered red lead and carbon black better than two coats of carbon black. W. A. Buchanan told of steel freight cars painted with carbon paint in good condition after 17 years.

SELECTION AND PURCHASE OF PAINT

BY S. E. BREESE
Foreman Painter, New York Central, Collinswood, O.

Previous to the advent of the United States Railroad Administration the master painter of the railroad was the sole authority as regards paint and varnish both as to materials used and methods of application, and was responsible to his immediate superior for the results obtained. By virtue of this authority and through his experience and ability he secured certain desired results acceptable to the road which employed him. He accepted full responsibility as to results obtained and viewed with pride the results of his work. This pride was justified by the condition and appearance of the equipment coming under his jurisdiction. By an interchange of ideas, the foreman painter was constantly striving for progressive methods, economy, labor saving systems and durability in his work. He chose his tools, his men and his materials and through the proper co-ordination of all three secured results. The questions which I believe are of paramount importance are, whether the above conditions still exist and whether we are still responsible for results and have authority as to what tools to use, methods to employ, or materials to apply.

At the present time the purchasing department chooses and gives us our tools and material and asks for results. Are we allowing our responsibility to be shifted, our authority to be questioned and our methods attacked and submitting to it all without a protest? We were employed for a specific purpose, namely, to maintain equipment in good shape, secure economy as to methods, costs and time factors and yet are unable to choose our methods or materials. If this has come about what is the cause and what is the remedy?

MASTER PAINTERS SHOULD CHOOSE MATERIAL

A successful organization is one in which the authority vested in each department is absolute and co-ordinated and results are obtained only by a complete assumption of responsibility by the head of each department. In this way a chain of organization is forged, which is strong, well co-ordinated and successful only when each department has this full authority. Are we allowing our department to become the weak link of the railroad shop organization by a question of divided authority or a shifting of responsibility? It is essential that we become cognizant of the real danger of shifting our responsibility, accepting divided authority and lowering our standard methods and materials.

I believe the greatest trouble has been with material rather than with methods of application. This is primarily in the hands of the purchasing department and there has been some little friction over the materials bought for use. Due to the very nature of each department's position, there must necessarily be some friction, as the office of the purchasing department is the securing of materials designed to accomplish certain specified purposes at as cheap a price as possible with due regard for the quality and durability of the articles purchased. The purchasing department must, because of its lack of knowledge concerning the materials used, be absolutely dependent as to the question of durability and quality on information secured from the mechanical department, which in turn secures this information by co-operation with the master painter. This information is obtained by a consideration of a number of essential points including practical equipment tests and weather tests, chemical tests, information secured through the sales representatives of paint and varnish concerns, regarding the tests made by them of the material in question, and the knowledge and experience of the master painter due to his specialization on these problems.

CHEMICAL TESTING OF PAINT

The chemical testing of varnish or paint materials has been up to date of little value as a reliable source of information, especially as regards durability. In fact, up to date, except in the case of raw materials, a chemical test is of no use to the painting department. The experienced painter by a few practical tests, such as elasticity, working and drying, can usually determine and foretell through his experience the possible durability of the article in question. General Atterbury has stated "In my experience the only materials which we were unable to purchase by specification were paint, varnish and rubber. In the purchase of the above materials, I was absolutely dependent for information on the man in closest touch with the materials, who by his specialization and experience usually could be called upon to adopt the material best suited for the purpose." This still holds true.

The purchasing department backed in many cases by the arguments advanced by sales representatives have succeeded in selling the mechanical department materials against the judgment of the master painter, who accepts these materials rather than get into a controversy. This has brought about changes in materials and standards all tending towards less efficiency and lessened durability, which means higher cost of maintenance in the end. This false economy is now being felt by the equipment upon which it was used. Goods of every description and standards are pouring into the shop; changes are being made from month to month on nearly all materials. Our only duty seems to be to apply them.

INFERIOR MATERIAL NOW BEING USED

As the price of raw materials advances, the price of paint and varnish declines, a queer economic anomaly which is only explained by a reduction in quality. The purchasing department notwithstanding the above, continues to buy at still lower prices, without consideration of durability or the standards of the road. This is a direct infringement on the authority of the man who, by his experience and specialization, has been placed in the position of the final judge of paint efficiency and durability. It is part of our job to make decisions regarding durability and efficiency. We have all seen certain materials installed as a standard for painting, whose false economy, is now becoming apparent, and which was apparent to us in the beginning. What is the remedy of this situation? A sales representative told me that any justifiable complaint made to the person in direct charge was always seriously considered by the purchasing department in placing orders, but as the complaints are not made, the purchasing department establishes a precedent for the purchase of still cheaper material. Have we been afraid to complain, have we refused to use materials for the purpose intended? The refusal of these materials would also establish a precedent for the discontinuance of the purchase of such materials. Let us not close our eyes to apparent faults without attempting by honest argument and frank discussion to remedy the situation. Let us carry this to a successful conclusion and put our association back of the fight for efficiency, economy, and durability of all forms of painting equipment, and retain full and undivided authority as to methods employed and standards adopted.

DISCUSSION

The members as a whole agreed that much poor material was submitted and accepted where paint was bought on specifications only. Several stated that material received under present specifications was not satisfactory. Although experience indicated that the paint would not give good service, it met the tests prescribed and for that reason there was no alternative but to accept it. J. W. Gibbons (A. T. & S. F.) emphasized the fact that the efficiency of painting should be judged not by the number of cars painted for a given expenditure, nor the speed with which the work was completed, but rather by the length of the intervals between painting.

BEST QUALITY AND SIZE OF SAND FOR SAND BLASTING

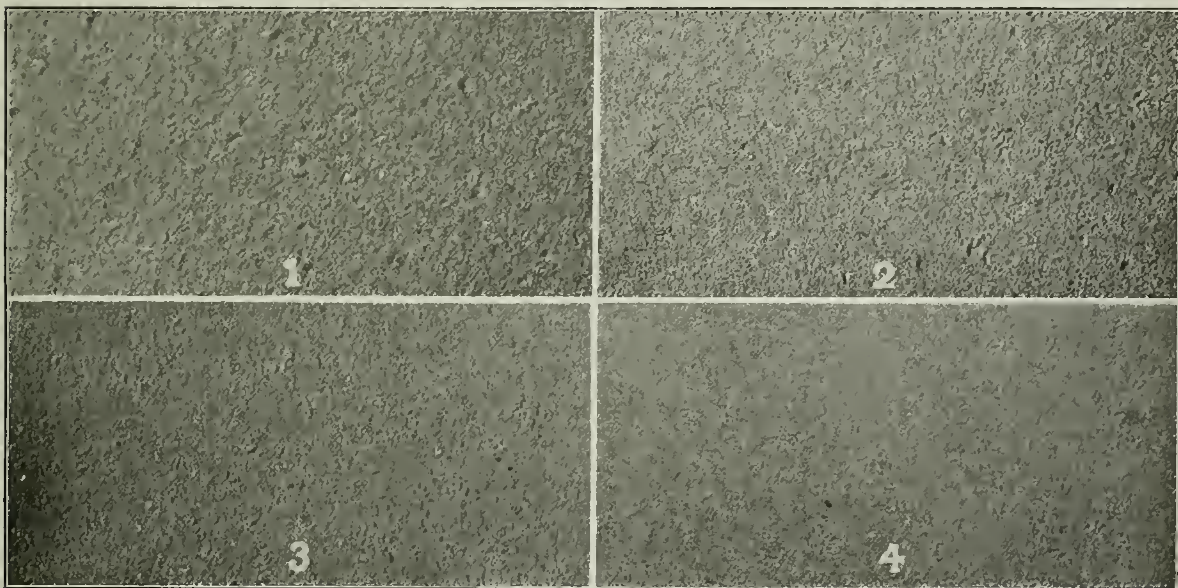
BY J. W. GIBBONS

Foreman Locomotive Painter, Atchison, Topeka & Santa Fe, Topeka, Kan.

Experience having taught us that the sandblast is the most economical and thorough method of removing the flash scale corrosion and old paint from a metal surface, economy of operation has been the only thing considered, durability or cost of finishing the surface has been lost sight of, with the result that a surface which was practically impossible to preserve with paint, has frequently been obtained. This naturally raised a doubt in the minds of some as to the desirability of using a sandblast in preparing a metal surface for paint. Even in conventions of this association, the durability of paint applied over a sandblasted surface compared to a non-sandblasted surface has been questioned. This state of affairs has held particularly true with regard to steel roofs.

The above facts, no doubt, prompted the committee in their selection of the above question for discussion. In my opinion, the essentials necessary to secure good results from sandblasting metal preparatory to paint, are the quality and size of the sand pebbles and the velocity and volume of the projectiles thrown against the surface. As to quality, any sand that is hard and firm will answer. The less dust or dirt it contains the better from every point of view. As to the size of the sand pebbles, I submit four photographs to show the results secured with various sizes.

A photograph of a steel plate sandblasted with sand run through a 4 by 4 mesh sieve is shown in Fig. 1. Note the torn condition of the metal; the pin points are numerous. When paint is applied over a surface like this and subjected to the attrition of wind, rain, sleet and cinders, incident to service conditions, the sharp projections puncture the paint film, allowing moisture to seep under the paint, carrying with it all the destructive agencies of the sulphurous products from coal burning locomotives or furnaces. Corrosion sets in, deteriorates and frequently destroys the metal before we realize that anything is wrong.



No. 1 Blasted with Sand Sifted Through 4 by 4 Mesh, No. 2 Through 6 by 6 Mesh, No. 3 Through 10 by 10 Mesh, No. 4 Through 16 by 16 Mesh Screen

Fig. 2 is a photograph of a plate sandblasted with sand run through a 6 by 6 mesh sieve and is practically as poor a surface to paint over as that shown in Fig. 1. A photograph of a plate sandblasted with sand run through a 10 by 10 mesh sieve is shown in Fig. 3, while Fig. 4 shows a plate sandblasted with sand run through a 16 by 16 mesh sieve. Figs. 3 and 4 present an ideal surface or paint with just sufficient roughness to give tooth to the paint and hold it firm and solid.

These plates were all cut from the same piece of sheet stee and sandblasted with the same quality of sand. The velocity and volume of projectiles was also the same on all plates, the only difference was in the size of the sand pebble and, in my opinion, proves that the size of pebble enters largely in the results obtained by sandblasting.

The second part of my claim, that the velocity and volume of the projectiles are also essential, may not be as susceptible of proof by photographs, but if you take a sheet of steel and throw a heavy volume of sand upon it with a high velocity, you will find that it will not only tear the metal, but will warp the sheet.

When we consider that sand run through a 16 by 16 mesh sieve will clean practically as much surface in a day as sand run through a 6 by 6 mesh and that the only extra cost is in the time required to sift the sand and in the per cent of sand available, and that this extra cost is more than made up in the time required to paint and surface up the metal, there can be no excuse for using a coarse grade of sand. As to velocity and volume of projectiles, in my judgment, the air pressure should not be less than 70 or more than 90 lb. per sq. in., and the size of nozzle should not be over 3/8 in. or less than 1/4 in. in diameter. To secure durability of paint surface and the proper protection of metal, the character of surface obtained by sandblast is as essential as the quality of paint applied.

DISCUSSION

G. M. Oates (Pressed Steel Car Company), presented a paper on this subject. his company formerly used No. 8 crushed quartz from Warsaw, Wis. The material was satisfactory, but on account of the high freight charges, its use was discontinued and No. 3½ silica from Youngstown, O., had been substituted with good results. Silica sand, however, will only remove rust and scale while the quartz will cut old paint as well.

SUBSTITUTE FOR LINSEED OIL

BY. A. H. F. PHILLIPS
Master Painter, New York, Ontario & Western, Middletown, N. Y.

There have been great demands for linseed oil, and some specialists predict that the call for seed to fill these large contracts will become so urgent that higher prices will eventually be realized. If such is the case, it will mean almost a prohibitive price for use in a railway paint shop. We can at least safely say that the demand is very great and is persistent.

There has been a general shortage in flax seed, which still continues. The Canadian and American supply continues light, and Argentine conditions are not changed particularly. Prices and freight are high, and cargo space at a premium. American buyers have been credited with considerable stocks in warehouses, but receipts and available supplies are somewhat limited.

Under the present conditions of the market, the demand for linseed oil is in excess of the supply, and there is no question that there is a genuine shortage of oil. Perhaps, at some future time when the market becomes more normal the supply may possibly equal the demand and prices may not be so high as to almost prohibit the use of linseed oil as a paint making oil.

PROPERTIES OF VEGETABLE PAINT OILS

For some time past the railway paint shops have been receiving many paint oils as substitutes for linseed oil. I believe there is none, as yet, equal to linseed oil as paint making oil. A paint oil as a substitute for linseed oil for use in the railway paint shop can be made, and is being made and sold by many companies, on a linseed oil base, and of the same gravity. This drys with a good gloss, as it contains enough of volatile oils as conveyors to assist materially in the application of the paint when evaporated in drying, leaves a thoroughly elastic and highly protective oil film in combination with the pigment. This paint oil can be used in thinning out paints of any character, oxide, carbon, lead or zinc, where oil is desired as a thinner, without danger of any chemical action. Such oil would probably be called a combination oil. I am not prepared to assert what oils make up such a paint oil.

Vegetable oils are used by many in making up their paint oils, namely, cotton seed oil, soya bean oil, hempseed oil, corn oil, peanut oil, cocoanut oil, etc. These vegetable oils being largely food oils and used extensively in paint making oils as substitutes for linseed have found an increasing market. Mineral oils are also used in the paint oils to some extent, but I do not think it advisable to be too free in the use of paraffin oils. Owing to the great demands for linseed oil and the scarcity of the supply, also prices soaring up almost to a prohibitive figure for general use in the paint shop, substitute oils have found a place in making paint oils for use in the railway paint shop.

OILS OTHER THAN LINSEED USED IN PAINT

There are quite a number of these, drying, semi-drying and non-drying and not a few have their special uses in paint. The most important of the drying variety is China wood oil or tung oil. Poppy seed oil is prominent for grinding the finer grades of zinc white and artists' colors, and must be classed among the drying paint oils for the reason that when pressed from ripe seed it dries very nearly as rapidly as raw linseed oil. The reason for the use of poppyseed in colors or paints is due to the non-darkening of this oil and its free spreading. Bombay nut oil was at one time largely offered at a price somewhat lower than poppyseed oil. It was very clear, almost water white, and its drying property fully equal to that of bleached linseed oil. However, this oil has not been heard from in the market for some time.

Sunflower seed oil is also classed among the drying oils, but it has not found its way into general commerce and therefore nothing more is known about it than has been ascertained in an experimental way. Hempseed oil also belongs to the class of vegetable drying oils, but this seed being raised principally in Russia and a few other localities in Europe, is used mostly there as a paint oil; and if any is brought to this country is comes as an admixture with linseed oil.

Another vegetable drying oil that has been largely imported for some time into this country and Europe, under the name of candle nut oil by soapmakers and is known to science as Kukui oil, is now being tested by progressive varnish and paint manufacturers. It bids fair to be a strong competitor of linseed oil when its characteristics become better known to the trade and it is prepared in a more scientific manner than it is now. Other drying vegetable oils, as nigerseed oil, tobacco seed oil, Scotch firseed oil, etc., that are not readily obtainable in commerce, are not at all interesting to the paint maker and color grinder.

FISH OIL HAS LIMITED USE

Another oil, which is of animal origin, is the fish oil known as Menhaden oil. This is barred out, however, from use in many paint materials, especially in interior paints, because of its offensive odor, and is made use of only in special outside paints as in roof paints and stack paints, and by some manufacturers in other specialties.

Among the substitutes for linseed oil that interest paint manufacturers most should be classed soya bean oil, corn oil and cottonseed oil. Soya bean oil requires fully ten days to dry to a film and then the film will not be as firm as raw linseed oil which requires six days to dry to a film. Since linseed oil is extraordinarly high priced there is quite a demand for bean oil, and it is quite a task for paint makers to discover methods to make their products dry in the ordinary way. The usual practice was to use equal portions of soya bean oil and boiled linseed oil, or when this would not work out well in some paints the bean oil portion was increased and also the driers.

Corn or maize oil has been in use in paints for many years, but is made use of only when linseed oil is high in price. This oil has very little, if any, drying properties, and will harden to a brittle, rather mealy film in from twenty to thirty days. Cottonseed oil has no drying properties, but is a good lubricant, and previous to its rise in price when it came to be used as a cooking and table oil, it was used to adulterate linseed oil. Rosin oils are not only used in printing-ink making, but were largely employed in making paint for rough surfaces, though since their price has advanced to twice, even three times their former cost, they have been replaced by mineral paint oils to a great extent in paint. Rosin oils are practically non-drying, and while they harden in time will soften again under the influence of sun heat and make the paint film part, or alligator. Pine oil and tar oil are products from the distillation of wood spirit and of rosin, and are used in the manufacture of marine paints, especially paints for ships bottoms. These oils are semi-drying and water resisting to a degree.

MINERAL OIL WILL NOT RESISIT MOISTURE

Mineral paint or paint and putty oil, so called among the trade, is refined petroleum or neutral oil, so named because debloomed. These oils cannot be used without being mixed in certain percentages with boiled linseed oil, as they lack binder and are apt to wash off the surface in case of driving rains. Even when used in large portions in a liquid paint for rough surfaces such paints have been known to wash off when they were supposed to have dried hard a month or two before. Petroleum products of this class will sweat, thus causing softening of the film and consequent damage to it by water.

Cheap paints for use on rough lumber or other rough surfaces can be made by grinding the base in linseed oil (usually boiled), thinning with a mixture of about 35 gallons of gloss oil (rosin and benzine mixture), 10 gallons of raw linseed oil and 5 gallons of liquid drier. Or if it must be still cheaper a thinner can be made of 30 gallons of gloss oil, 15 gallons of debloomed neutral paraffin oil and 5 gallons of lead and manganese drier. In any case, however, the pigment to be used as the base for the paint should be ground in linseed oil

So far linseed oil has not found an equal in paint making, although the subject has been one of deep study, and while other fixed oils have been discovered that for certain purposes have been expected to take its place, it has yet to be demonstrated that such is really the case in long practice. China wood or tung oil, while superior to linseed oil in certain directions, especially in its resisting power to water, has not shown itself adapted to replace linseed oil in making oil paints as we know and desire them.

When linseed oil is placed on a strip of glass that has been painted jet black and shows a bloom, or iridescence, it is adulterated with mineral oil or rosin oil. Admixture of linseed oil and corn oil or linseed oil and cottonseed oil can be detected by placing some of the oil between the palms of the hands, rubbing briskly and noting the odor thus emitted. The presence of soya bean oil, however, cannot well be ascertained by simple tests, and a chemical analysis is necessary, though even that is sometimes misleading.

THE FIELD FOR SUBSTITUTE OILS

BY P. J. HOFFMAN
Master Painter, Hocking Valley, Columbus, O.

The shortage of linseed oil makes it imperative that we find an acceptable substitute oil. In some instances, it is absolutely necessary that we use linseed oil, but on the other hand, whenever we can use a substitute with the desired results we are saving that much linseed oil to overcome the present shortage. Tung oil is used very extensively in the place of linseed oil in the manufacture of certain grades of varnish, and a mixture of tung oil and linseed oil has a greater resistance to moisture than the pure raw oil, consequently in cases where the paint is subject to the rains, snows, sleets, etc., such as platforms, trucks, or castings, it is an improvement over linseed oil. Then again, certain oils will stand the heat better than linseed oil, and therefore are better fitted for the heated parts of locomotives, etc. There is on the market a substitute oil for the grinding of pigments that has given universal satisfaction. I have for a number of years used a substitute oil in all our freight car equipment that has fully stood the test, especially in point of service rendered.

Different bodies and surfaces require different substitute oils according to the nature of the object painted and the kind of usage the paint has to withstand. How far we can go with a special paint for a special purpose is in my opinion the solution to the question. If we can by diligent research conserve the linseed oil by the use of a substitute oil, we have overcome some of the shortage of the linseed oil. The difficulty in using substitute oils is that irresponsible companies will make and market an oil substitute that has no virtue and we will try one and then another without getting results until at last we will become so disgusted that we will revert back to the old reliable linseed oil.

Unless we can have a certain paint for a certain purpose, I am skeptical as to the advisability of using substitute oils. Then the question arises is it practical from a money standpoint. We will have great quantities of different kinds of paints that are used only on certain jobs and the stock will be so augmented that the stock room will have to be enlarged and in all probability it will necessitate the adding of more help to take care of the stock. Then again the loss of interest on the money that is tied up in the excess stock paint will have to be considered, loss from evaporation and deterioration from paint exposed at long periods make it even more expensive. These with the many more added expenses that are sure to be incurred with larger stocks will, to my mind, overcome all that can possibly be saved by attempting to use substitute oil.

DISCUSSION

A paper on this subject was also presented by F. B. Davenport (Penn. Lines). J. W. Gibbons (A. T. & S. F.) stated that mineral oil should not be used with putty as it evaporates and leaves a powder that soon flakes off affording no protection for the glass. Good putty effects a saving of glass and labor many times greater than the increased cost of the material. Mr. Gibbons stated that linseed oil is not necessary in paint that is not exposed to the weather.

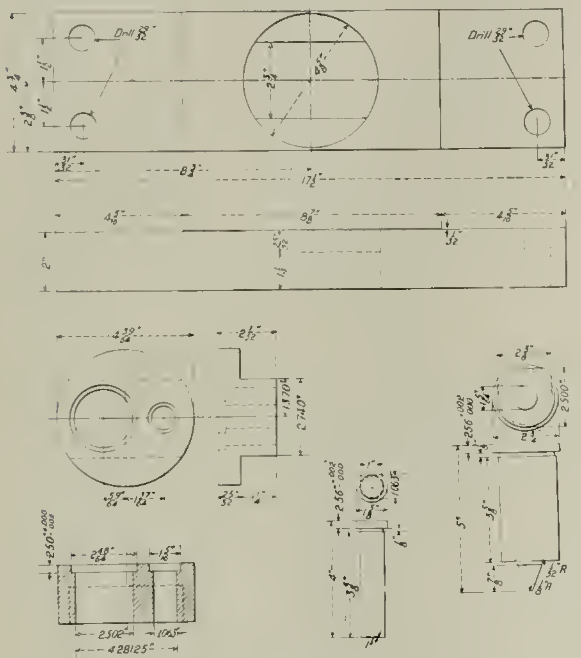
OTHER BUSINESS

F. B. Davenport (Penn. Lines) told of the results secured with a special heat resisting paint developed for use on car roofs. C. E. Copp (B. & M.) presented a paper on the record of the Master Painters' Association. Papers on Painting of Steel Equipment and Roofs of Passenger Cars will be found in the Car Department of this issue.

The secretary-treasurer reported a total membership of 328 and a satisfactory balance in the treasury. The following officers were elected: Chairman, J. W. Gibbons (A. T. & S. F.); first vice-chairman, E. L. Younger (Mo. Pac.); second vice-chairman, J. G. Keil (N. Y. C.); secretary-treasurer, A. P. Dane (B. & M.). Boston was chosen as the place of the next meeting, which will mark the fiftieth anniversary of the founding of the Master Car and Locomotive Painters' Association.

WASHER PUNCHING DIES

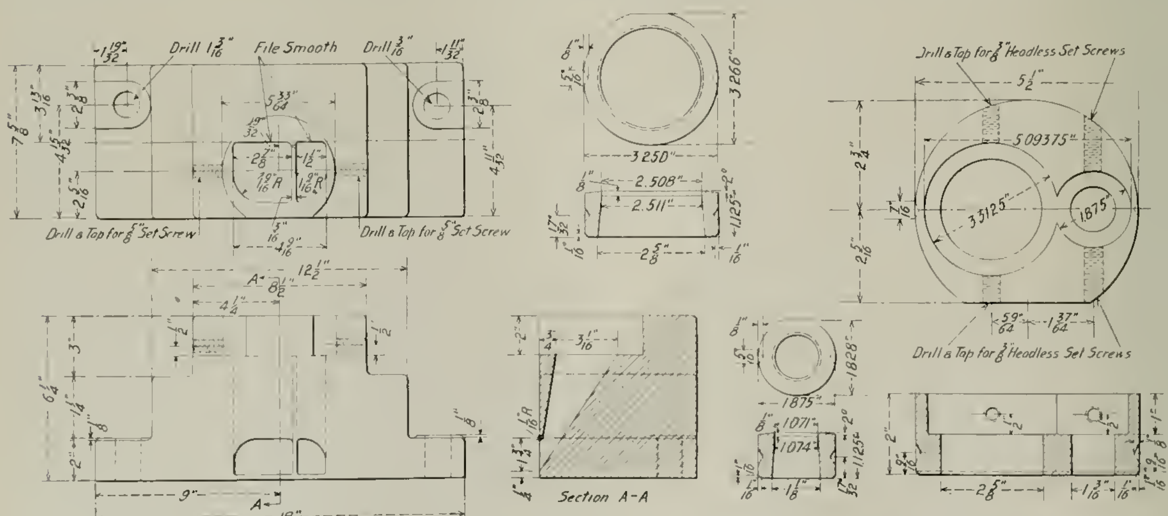
The dies shown in the drawings have been developed for punching washers from scrap material, at the reclamation plant of the Canadian Pacific at Angus shops, at Montreal, Que. The device is arranged in a single unit, consisting of two sets of punches and dies, one of small size to cut



The Punches, Punch Holder and Block for Attaching the Punches to the Machine Crosshead

the bolt hole and the other large enough to cut the washer out of the plate.

The punches are held in a steel holder, which is set in a steel block bolted to the crosshead of the machine. The dies are held in a steel holder set into a cast iron block which is bolted to the table of the machine. The cast iron base block has two chutes cored through it so that the washers and punchings may be kept separate. The large or outside punch has a guide which enters the hole cut by the small or bolt hole punch, thus making the outside of the washer concentric with the bolt hole.



Details of the Dies, Die Holder and Die Block

In operation the plate is first placed under the small punch; thus it is advanced until the guide on the large punch will enter the hole just cut by the small punch. After the first small hole is cut, every stroke of the machine produces a completed washer. A stripper is placed 5/8 in. above the dies which extends half way around both punches from the back, so that as the punches move up the plate is stripped off from them.

The advantage claimed for this device is continuous production. It is simple, and there are no moving parts to the stripper to break or get out of working order. Punches and dies similar to those shown, which are 1-in. washers, have also been designed for 1/2-in., 9/16-in., 5/8-in., 3/4-in. and 7/8-in. washers.

AUTOGENOUS WELDING OF FIREBOXES

In an article entitled Jacobs-Shupert Firebox Repairs, written by H. Louis Hahn of the Santa Fe System and appearing in the August issue of the *Railway Mechanical Engineer*, the following statement was made: "These patches meet the requirements and approval of the Interstate Commerce Commission, Division of Locomotive Inspection."

Exception is taken to this statement by A. G. Pack, chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission, in a statement reading as follows: "This bureau has consistently taken the position that autogenous welding should not be permitted on any portion of a locomotive boiler wholly in tension while under working conditions, nor in any part of the boiler where the strain is not carried by other construction, or where the safety of the structure is dependent upon the strength of the weld."

A New Heat Insulating Material.—According to the Valve World, a new heat insulating material, composed of a mixture of a special clay and cork, has been discovered by a Norwegian engineer. The clay and cork mixture is burnt, and the result is the formation of a very light substance that is said to be eminently suitable for all heat insulating purposes.

Railway Tool Foremen's Convention

Standardization of Small Tools and Devices for Facilitating Work Are Principal Topics Discussed

THE American Railway Tool Foremen's Association held its ninth convention at the Hotel Sherman, Chicago, August 27-29. Following the opening prayer, the convention was welcomed by G. C. Niemeyer, representing the states attorney. The president then introduced W. E. Dunham, assistant to the general superintendent motive power and car department, Chicago & North Western, who spoke of the relation of the tool foremen's work to the efficiency of the shop.

ADDRESS OF W. E. DUNHAM

Mr. Dunham said in part: The tool foremen and the tool foremen's organization are the heart and life of a railroad shop. What the tool room is and what the tool room foreman accomplishes affects every department. If the tool room is not furnishing efficient tools, the morale and spirit of the entire shop is gone. The tool foreman ought to give attention to every tool in the plant, and those from which the proper output is not being secured should be overhauled so that the utmost production can be obtained. We must see that the equipment the railroads have in their shops is in efficient condition. In this matter the Tool Foremen's Association has a very vital part to play in the reconstruction period through which the railroads are going.

PRESIDENT'S ADDRESS

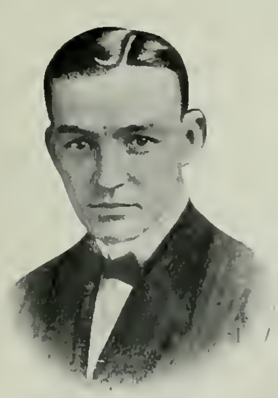
The president, C. A. Shaffer, general supervisor, shop machinery and tools, Illinois Central, reviewed the activities of the association since the last convention in 1916. He urged the members to put forth a special effort to enlarge the organization and to continue the work which would bring about higher efficiency in railroad tool service.

STANDARD DEVICES FOR LOCOMOTIVE

BY B. J. McKERNAN
Supervisor of Tools, A. T. & S. F., Topeka, Kan.

There has been a great demand for practical devices for use in making repairs to locomotives and cars, and through the efforts and cooperation of the American Railway Tool Foremen's Association many good devices and ideas have been disclosed. There are shown below a few devices which have been found to be very practical for the various classes of work here described.

Several practical devices used in making repairs to air brake equipment are shown in Fig. 1. By the use of these tools we have been able to reclaim many parts that otherwise would be considered scrap, and from a financial stand-



C. A. Shaffer (I. C.)
President

J. C. Bevelle (E. P. & S. W.)
First Vice-President

R. D. Fletcher (Belt Ry. of Chic.)
Secretary-Treasurer

point we have made a very creditable showing. These tools are made up in the Topeka shop tool room and standard sets are furnished to all points on the line.

Boiler check reseating tools and reamers which have proven very satisfactory for the repairing of boiler checks in the back shop and especially in the roundhouse in making running repairs are shown in Figs. 3 to 5. These devices are inexpensive and very simple to make and handy to operate, and they are instrumental in eliminating many engine failures and leaky boiler checks. In order to eliminate the possibility of our mechanics using improper tools on the leaky boiler checks, we found it advantageous to stencil each reseating tool with the pattern number of the casting for which it is intended.

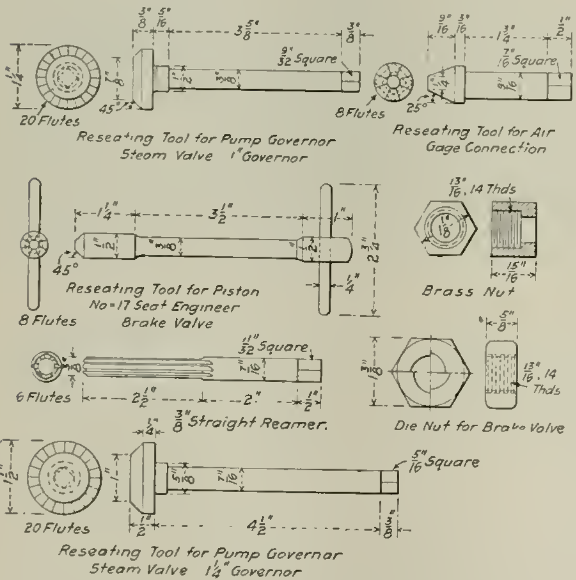


Fig. 1—Tools for Repairing Air Brake Parts

Reseating tools for blow-off cocks are shown in Figs. 5 and 6. By the use of these tools the possibility of leaks can be eliminated and the tool is so constructed that any one can operate it without difficulty. This tool is also stenciled for the particular boiler blow-off cock on which it is to be used.

Fig. 2 shows reseating tools for the outside and inside throttle valves for non-lifting injector, and Fig. 8 shows reseating tools for Chicago lifting injector throttle ram seats.

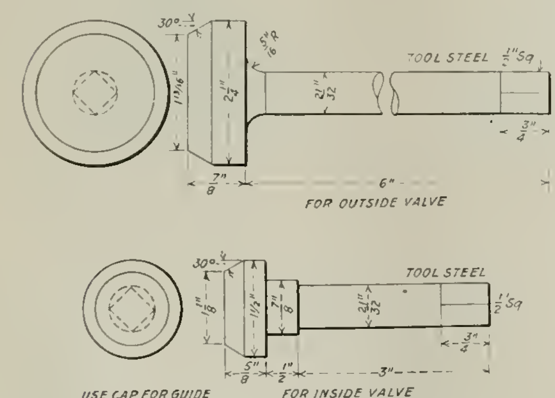


Fig. 2—Non-Lifting Injector Throttle Valve Reseating Tool

A lubricator throttle valve reseating tool is shown in Fig. 9. This tool has proven to be very handy and efficient, and all roundhouses are furnished with tools of this kind.

A reseating tool for superheater damper cylinders is shown in Fig. 10. We find that by the use of this tool we can eliminate the possibility of leaks to the cylinder, and it is indispensable.

STANDARDIZATION OF TOOLS.

In this day and age the individual idea should be subordinated to such an extent that we should adopt practices that would give us better efficiency, reduce the cost of output, and on the other hand simplify the tool situation whenever possible. It has been plainly shown that the adoption of standard practices by the American Railway Master

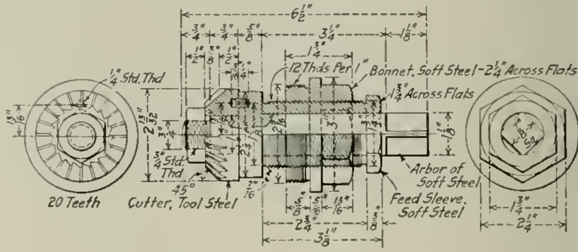


Fig. 3.—Reseating Tool for Ohio Boiler Checks

Mechanics' Association was a good move. When a standard practice was adopted by that body it was carried.

In the past eight years the members of the American Railway Tool Foremen's Association have attended meetings and returned to their respective homes and made reports to their local officials on these subjects, but unfortunately they did not get the co-operation that they should have received. As each of the tool foremen who attend these conventions receive instructions from their superiors to attend, they should be invested with such confidence that when they make a report to their superiors that a certain tool has met with approval of the association and been adopted as

Patt No	A	B		D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	Teeth U	Keyway V
LS 924	2"	2 5/16"		1 1/2"	1 3/4"	2 13/16"	1 1/8"	3"	3"	1 1/4"	2 1/4"	3 15/16"	3 1/8"	7/8"	2 3/8"	11/16"	3 9/16"	2 3/4"	5/8"	9 3/4"	30	3/16" x 3/16"
LS 2083	2 3/4"	3 1/8"		2"	2 3/8"	3 9/16"	1 1/2"	3 3/4"	3 3/4"	1 3/4"	2 3/4"	4 1/2"	4 1/8"	1 1/4"	3"	7/8"	4"	4 1/4"	7/8"	12 3/8"	40	1/4" x 1/4"

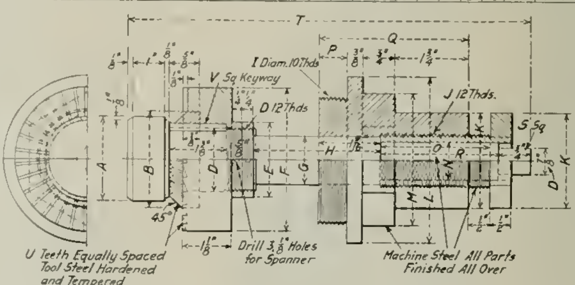


Fig. 4.—Boiler Check Reseating Tool

standard, the higher officers should put forth an effort to put this into practice. If we could standardize the tool equipment on all American railroads and use the same methods and practices there is no question that it would eliminate a great deal of the making of unnecessary tools. While I appreciate the fact that the tool room foremen and the superintendents of motor power have a certain amount of self-pride in the making of all tools for their respective railroads, nevertheless, the progressive man of today must be able to give and take whenever necessary in order that he may develop a method that will insure better production.

In the automobile industry, where all parts must be interchangeable, the first practice is to get the tools made to the standard before starting production and these tools are maintained to an extremely high standard of accuracy. If this is found to be good practice from a manufacturing standpoint, why is it not a good practice in the railroad shop? There is only one solution, and that is co-operation, and the insistence on the adoption of practical methods and standards.

On the Atchison, Topeka & Santa Fe, in order that we may get the proper results, it has been found very essential that the tools be standardized and, whenever possible, drawings are made of the tools and then submitted to the tool-room foreman.

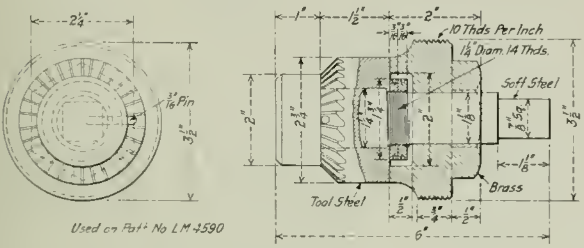


Fig. 5.—Boiler Check Reseating Tool

It is further found advisable that only tools which cannot be secured from the manufacturer for a reasonable price should be made in our tool room. It is not good practice for a railroad shop tool room to manufacture tools that can be secured from the manufacturers for the same price or less than it would cost to make them locally. In some shops such tools are made, but I consider it false economy due to the fact that there is a certain amount of loss incurred by the tool room, and when standard tools are secured from the factory all the possibility of loss is overcome, due to

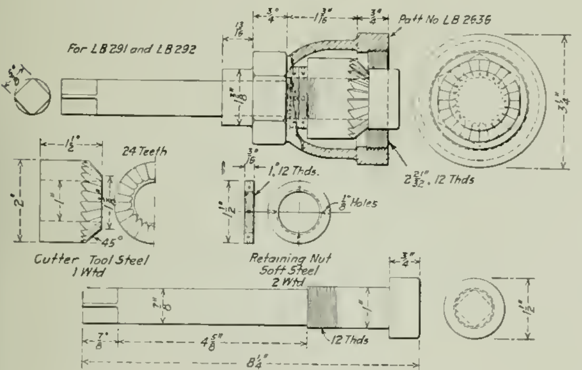


Fig. 6.—Reseating Tool for Blowoff Cock

the fact that all tools are furnished in first-class condition and free from flaws and defects.

There is a vast difference of opinion between railroads in regard to a standard locomotive frame reamer. The greatest difference seems to be in the length overall and in the taper. If a standard length and taper of locomotive frame reamers could be universally agreed on, it would be possible to eliminate the excess cost due to ordering the reamers as a special type from the manufacturer, as well as eliminating the carrying of many different lengths of reamers locally in the tool rooms.

For illustration, on the Sante Fe Lines a standard reamer has been adopted with a left-hand spiral flute and of a standard length that will take care of the maximum and minimum requirements. Heretofore, there were a great number of different lengths which have been eliminated by standardization. By the adoption of the left hand spiral fluted reamer, the breakage has been reduced to about 20 per cent. While using the straight fluted reamer trouble was encountered due to the chipping out of portions of the flute and also chattering, while now this has all been eliminated, for the left hand spiral retards the reamer to such an extent that it does not gouge or seize, especially while reaming steel frames on locomotives. All our reamers are tapered 1/16 in. in 12 in., and I feel confident that with the proper co-operation of the mechanical heads on the various railroads throughout the United States, this point could be agreed upon.

DISCUSSION

Several questions were raised regarding standard forms of reamers. There was some difference of opinion regard-

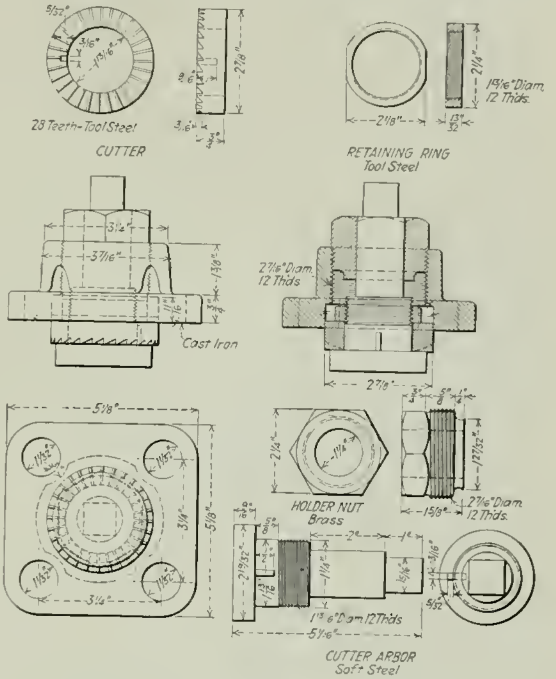


Fig. 7.—Reseating Tool for Blowoff Cock

ing the relative advantages of flute in the form of spirals having short and long pitches. The majority favored long spirals on reamers used with air drills, but the statement was made that the shorter spirals cut more rapidly, but required heavier thrust to feed them.

HEAT TREATMENT OF STEEL BY ELECTRIC FURNACES

BY HENRY OTTO
Tool Foreman, A. T. & S. F., Topeka, Kan.

There are in use at the Topeka tool room two high temperature electric furnaces and an oil tempering bath. The furnace used for extremely high temperatures has a carbon resister and carbon top plate. The service life of these plates is about 125 hr., while the graphite bottom plate and electrode have a life of about 300 working hours. This furnace is expensive to maintain as the high heat used cracks the walls inside of the carbon plate. This must be repaired, and it takes some time for the cement to dry so that the plates can be put back in place. This furnace has a range from 1000 to 2500 deg. F., but is seldom used above 2300 deg. F. In this furnace tools made of high speed steel are brought to the final heat.

A furnace of the hairpin heat unit type designed for lower temperatures is used for carbon steel tools. The maximum temperature secured in this furnace is 1800 deg. F. The heat units are easy to renew and the cost of maintenance is very low. It has been in constant use since March, 1917, and has had one renewal of the hairpin units since that time and one inner lining. It is the most used furnace in the tempering room. All carbon steel tools are heated for

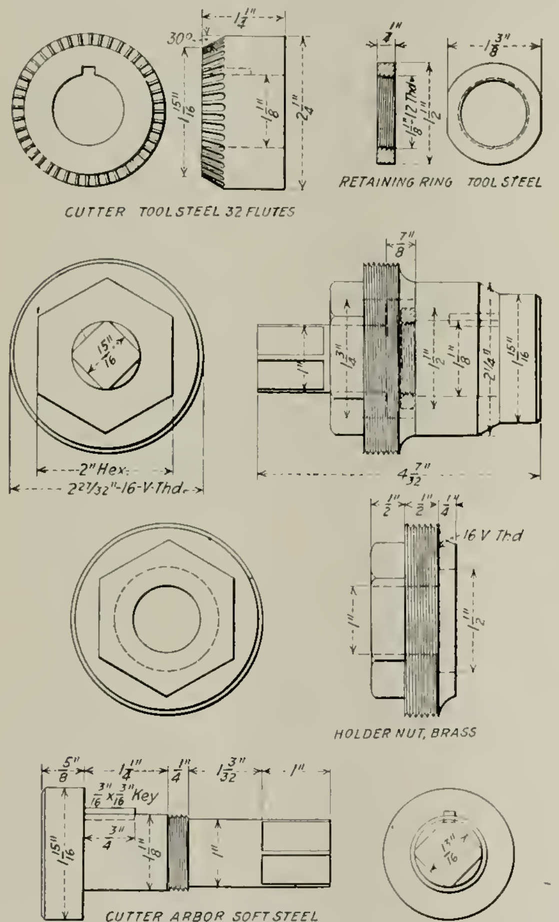


Fig. 8.—Reseating Tool for Throttle Ram Seat for Chicago Lifting Injector

hardening in this furnace and high speed tools are also preheated before going in the high temperature furnace.

The electric oil bath is a very necessary equipment in any up-to-date tempering room, as it draws the temper on carbon steel accurately. The oil is heated to the required temperature, the tool is left in the bath until it is heated through and then cooled in the atmosphere, after which it is ground.

When the blacksmith depended upon the color to judge the temperature at which to quench and draw tools, the work was often not done right. With electric furnaces and tempering bath and the pyrometer, the proper degree of heat can be secured and tools can all be uniformly tempered.

OTHER PAPERS

At the Thursday morning session W. H. Eisenman, of the American Steel Treaters' Society, spoke on the heat treatment of steel. He described the strange method followd by the alchemists in tempering steel, and traced later developments down to the introduction of alloy steel. He emphasized particularly the necessity for better heat treating equipment and the use of scientific methods in railroad shops. During the discussion which followed, much stress was laid on the importance of proper methods of forging and treating steel both for tools and for parts of locomotives or cars to be machined. E. J. McKernan (A. T. & S. F.)

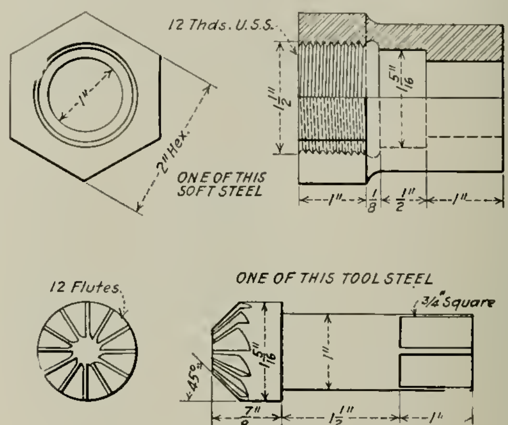


Fig. 9.—Reseating Tool for Lubricator Throttle Valve

stated that the use of pyrometers and scleroscopes had eliminated much of the trouble formerly experienced in hardening tools. F. Peterson (C. & S.) submitted a discussion of motors for tapping staybolt holes.

A discussion of the making of carbon steel forgings for tools was submitted by J. P .Fuhrmann (Great Northern). Descriptions of gages, tools and devices were also received from J. B. Hasty (A. T. & S. F.), A. Connell (K. C. S.), J. B. McFarland (N. Y. C. & St. L.) and J. Berling (S. P.).

GENERAL BUSINESS

The association discussed the advisability of amalgamation with the American Railroad Association, and a com-

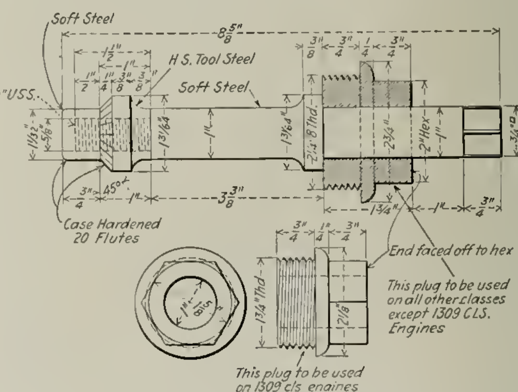


Fig. 10.—Reamer for Reseating Joints in Superheater Damper Cylinders

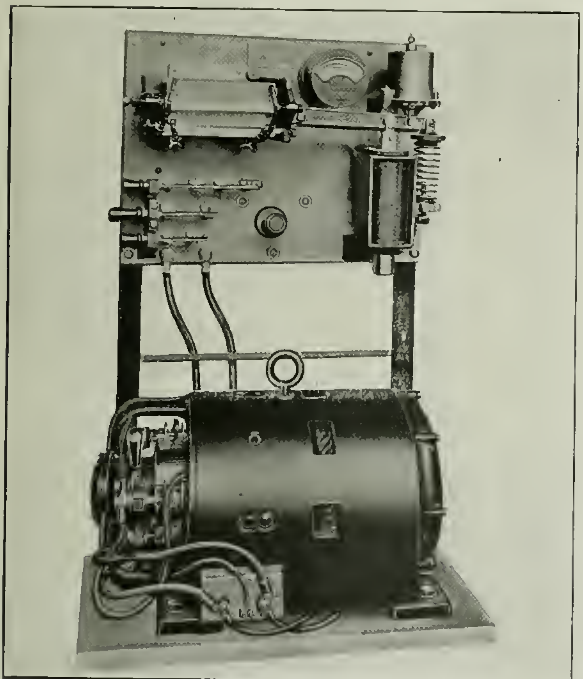
mittee was appointed to consider and report on that question. The secretary reported a substantial increase in the membership. The following officers were elected: President, J. C. Beville (E. P. & S. W.); first vice-president, J. B. Hasty (A. T. & S. F.); second vice-president, G. W. Smith (C. & O.); third vice-president, C. Helm (C. M. & St. P.); secretary-treasurer, R. D. Fletcher (Crucible Steel Company); chairman of executive committee, B. Hendrickson (C. & N. W.).

NEW DEVICES

THE PLASTIC-ARC WELDING OUTFIT

A new Plastic-Arc welding unit has just been brought out by the Wilson Welder & Metals Company, New York. This set is composed of a dynamotor and current control panel. The generator is flat-compound wound, and maintains the normal voltage of 35 on either no load or full load.

The control panel contains many new features. It has been designed to provide a constant-current controlling panel, small in size, of light weight, simple in operation and high in efficiency. The panel is of slate 20 in. by 27 in. and on it are mounted a small carbon pile, a compression spring and a solenoid working in opposition to the spring. The solenoid is in series with the arc so that any variation in current will cause the solenoid to vary the pressure on the carbon pile, thereby keeping the current constant at the value it is adjusted for. This gives a constant heat in the weld, and practically any metal can be welded without preheating or annealing.



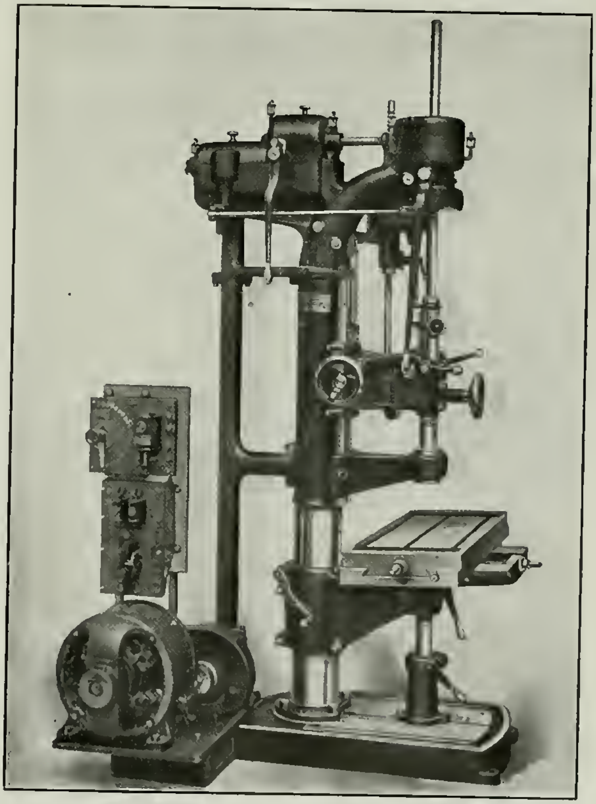
The Plastic-Arc Unit

Three switches on the panel provide an easy means of current adjustment between 25 and 175 amperes. The arrangement of the welding circuit is such that 25 amperes always flows through the solenoid when the main switch is closed whether the welding current is at the minimum of 35 amperes or the maximum of 175 amperes. The balance of the welding current is taken care of in by-pass resistances shunted around the solenoid.

This outfit can be furnished as a dynamotor unit, with standard motor characteristics, as follows: 110 volts 220 volts, DC or 220 440 volts, 60 cycle, two or three-phase, AC, also as a gasoline-driven unit, or it can be furnished without a motor, to be belt-driven. The normal generator speed is 1,800 r. p. m. The net weight of this new outfit in standard characteristics is 800 lb. with DC motor, 807 lb. with AC motor, 1,200 lb. with a gasoline engine, and 550 lb. as a belted outfit without motor. These new dynamotor sets can be mounted on a truck if desired, thus making a portable outfit.

THE FOSDICK HEAVY DUTY UPRIGHT DRILL

The Fosdick Machine Tool Company, Cincinnati, Ohio, have added to their line a new design of upright drilling and tapping machine. In general appearance the machine is similar to the average modern upright drill, but the characteristics are entirely different. The gearing arrangements, frictions, feeds, quick return, etc., are similar in detail to

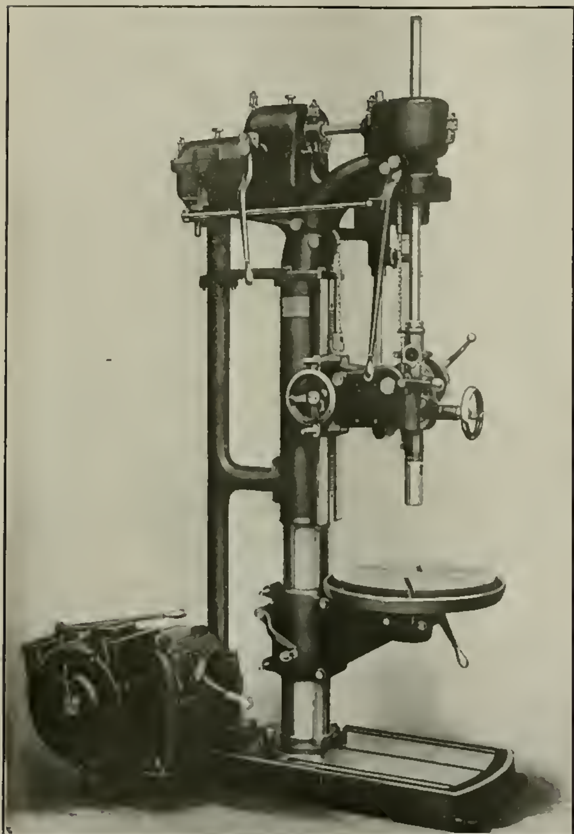


Variable Speed Motor Driven Machine with Compound Table the corresponding parts which are being used on Fosdick heavy duty radial drills.

The illustrations show the regular constant speed belt driven machine with round table, and the variable speed motor driven machine with compound table with micrometer dial adjustments and the vertical milling support. These have a capacity of 25 in. diameter of work and the weight is about 2,350 lb., and they are driven by a 7½-hp. constant speed motor.

The base of this machine is surrounded by a channel draining to a large reservoir for drilling compound, and is so designed that bolts may be entered from either end of the T-slots.

The table arm has an unusually long bearing on the column and is internally ribbed similar to a bridge or roof truss



Constant Speed Belt Driven Machine with Round Table

which greatly increases the rigidity. The table is raised and lowered from either side of the machine, may be swung around the column to clear the base for large work and cannot accidentally drop when unclamped. The unique arrangement of the table T-slots allows them to terminate very close to the center, allows heavy ribs to run directly toward the hub, permits work of any shape to be securely clamped and prevents bolts from flying out should they become loosened while drilling.

The spindle head is raised and lowered by a handwheel, and not being burdened with the heavy feed arrangement, is perfectly counterbalanced. The spindle is provided with a depth gage and automatic trip which may be set to graduations in any position in the entire length of travel. A safety trip at the limit of traverse prevents accidents. The spindle quick return acts instantly, requires but one hand to operate for sensitive drilling, for tapping, for rapid lowering or return of the spindle, with or without disengaging the power feed or the hand wheel feed.

Five feeds are obtainable ranging from .004 in. to .028 in. per revolution of spindle. The power feeds are all obtained by a single lever, within easy reach of the operator while seated, although it has been placed high enough not to interfere with the operating levers on the head. The hand feed may be fed ahead of the power feed without disengaging the latter. This is particularly advantageous in starting large drills.

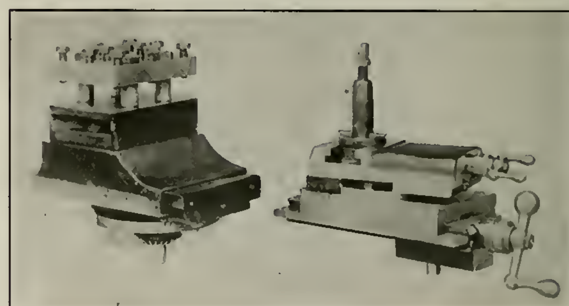
The friction reverse tapping mechanism is embodied in the construction of all machines, and being placed between the initial drive and the back gears, the power transmitted to the spindle is six times as great as in the spindle friction type. The bronze bearings are driven in bored holes, no babbitt metal being used in the machine. Ball bearings take the principal thrusts, including the spindle, both crown gears, the vertical driving shaft and friction bevel pinion, the feed worm and feed bevel gear. A metal chart showing speeds and feeds for high speed work is attached to each machine.

The machine is driven by a constant speed belt through the gear box, which furnishes correct cutting speeds for drills ranging from 3/16 in. carbon to 2½ in. high speed, with slower speeds for heavy tapping and for boring up to 5 in. diameter. Twelve spindle speeds are obtainable ranging from 49 to 550 r.p.m. Constant or variable speed motors may be supplied even after a belt driven machine is installed, as all styles of drive are interchangeable without requiring a special base. Pump and piping for drilling compound include a flexible tube to the point of the drill.

THE MULTI-CUT SERVICE LATHE

The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, have developed a semi-automatic lathe which has many distinctive features. As its name signifies, a number of tools are in operation at the same time. The machine is easily and quickly set up. There are no cams either fixed or adjustable to consider. One or more facing and turning operations can be performed simultaneously, one operator running several machines.

The work may be centered, held on arbors, expansion or



Multiple Tool Blocks

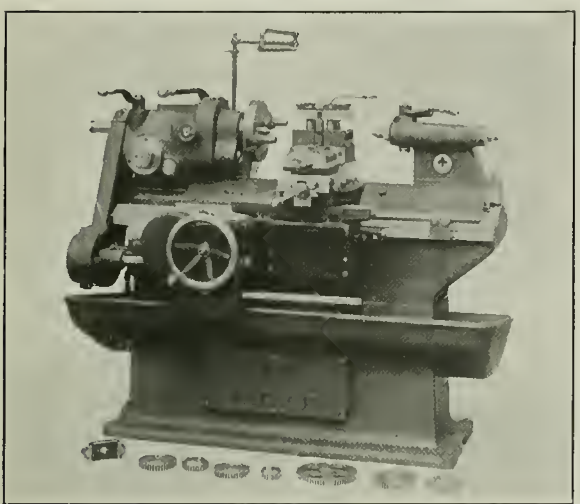
closer chucks, either pneumatic or hand-operated. The Multi-Cut is specially adapted to work that has been previously bored, reamed and rough turned on the turret or automatic lathe and remains to be finished, turned and faced.

PLAIN AND UNIVERSAL FACING ATTACHMENT

The plain facing attachment faces diameters up to the full swing of the lathe at right angles to the turning center. The feed of the facing slide is obtained entirely by the relative movements of flat and dovetail slides accurately gibbed and adjustable to compensate for wear. The facing rest is fed towards the center of the lathe on a broad square lock slide to which it is accurately gibbed. The cross facing slide is movable along the bed and may be rigidly clamped to the shears in any desired position.

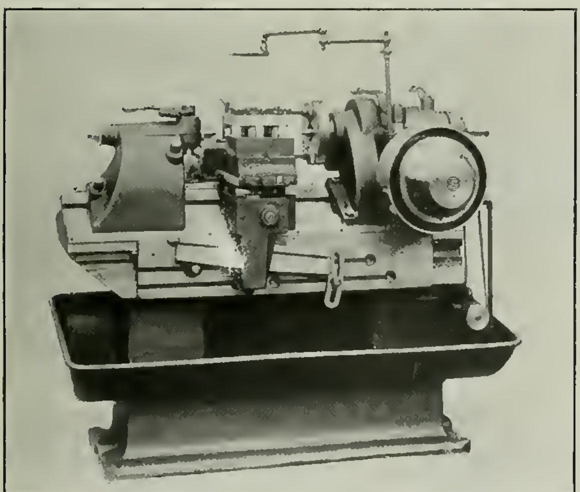
The facing bar slide carries the swivel guide bar which is fed along the bed at varying rates of speed.

A sliding shoe on the facing attachment slide engages the swivel guide bar which may be sent at any angle within the



Multi-Cut Lathe No. 9

range, imparting a vertical motion to the shoe which is transmitted through a rack and pinion to the cross slide. By changing the angularity of the swivel guide bar the feed of the cross slide may be varied to complete its work at the same time as the turning slide or may be accelerated to finish ahead of the turning slide to permit of overlapping on form-



Rear View of Lathe Showing Right Angle Drive

ing and turning tools or it may be retarded to finish after the turning slide.

The feed to both turning and facing slide are tripped by the same clutch and will duplicate within close limits of accuracy.

The standard tool block furnished is arranged for multiple tools which can be held parallel or at any angle by reason of the spacing of the binder screws. The tool block is adjustable to the center of the lathe and firmly clamped in position by two heavy bolts.

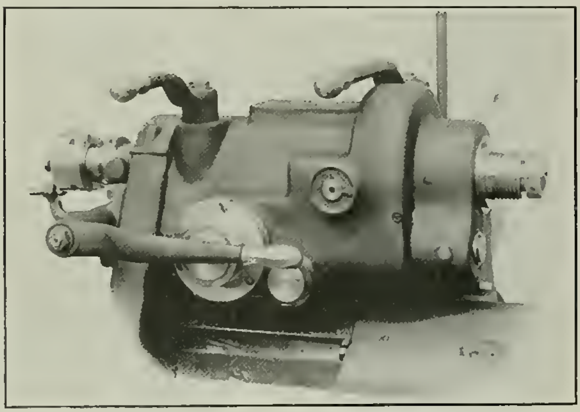
The universal facing attachment, as its name indicates, is adapted to angular facing operations on bevel gears, etc. When used in connection with a taper turning attachment the back and face angles can be turned simultaneously.

The swivel block is accurately graduated to facilitate angular settings and clamped firmly in the selected position by two heavy T slot bolts. The feed is through a pair of miter gears to the feed rack. Aside from this swivel feature the universal attachment and tool blocks are identical with the plain attachment.

Variations in feed for turning and facing slides are obtained by loose change gears applied to the feed bracket and worm box. The feeds read in "thousandths per revolution of spindle," and a simple, direct reading shows the change gear combinations and the resulting feeds.

The feeds of the front slide are fixed by the change gears used while the feeds of the facing slide may be further varied with relation to the feed of the turning slide by the angularity given the swivel guide bar.

The feed worm and wheel are on fixed centers and encased in an oil tight gear box rigidly bolted to the bed. The feeds are tripped to a line by a sensitive acting positive



Style B Headstock with Draw-in Attachment

jaw clutch heat treated and hardened engaging a similar clutch mounted on the worm wheel.

The feed drive is then through changeable gears and a pinion and bull wheel to the rack on the carriage. The drive to the facing slide is through similar change gears through the bed to the feed rack on the facing attachment slide on which the swivel guide bar is mounted.

The feed rack for both carriage and facing attachment is placed in the center of the slides imparting a feed without the usual binding action occasioned by applying the power off the center of the guiding shears.

The handwheel at the front of the worm box provides means of quickly returning the turning and facing slides to the starting position after the completion of each cut.

The worm wheel and clutch are running continuously in oil and the thrust of the worm is taken against ball thrust bearings.

The taper turning attachment consists of a rigid bracket bolted to the front of the bed, which carries an adjustable taper guide bar and a sliding shoe engaging the guide bar. The sliding shoe is attached to a cross slide imparting to it an "in" or "out" movement with relation to the angular setting of the guide bar. The guide bar may be set from straight to 4½ in. taper per ft., either side of center and clamped in the selected position by two heavy T slot bolts. The taper guide bar and sliding shoe may be replaced by a form plate and roller for the automatic duplication of irregular shapes.

The style B headstock is 6-speed selective geared, right angle driven. Three instantaneous changes are obtained with one lever, a shifter knob compounding these changes through a back gear for 6 speeds. The headstock is oil tight, the gears and friction clutches running in a continual bath of oil. The spindle bearings and driving clutch are also continuously flooded with oil from this same supply. The main friction clutch is mounted in the driving pulley, where it is operating at a constant high rate of speed and subject to little strain. It is of the multiple disc type running in oil, with a brake operating from the clutch handle. The driving pulley shaft is at 9 deg. to the spindle to permit of a more compact grouping of the machines. The spindle is fitted with taper bronze boxes, babbitt lined with means of adjustment for wear. The thrust is taken against ball thrust bearings.

A plain block rest, mounted on the cross slide, equipped with a single screw tool post and an adjustable positive cross stop, or a compound rest is supplied as conditions may require. The swivel is large in diameter and graduated in degrees for angular turning or taper boring. Adjustable taper gibs are provided to compensate for wear on the slides.

A quick lever acting tailstock is provided to permit of the quick removal and replacing of work with a single movement of the operating handle.

The center of the tailstock is brought into contact with the work at any desired pressure, by a conveniently placed lever, further movement of the same lever rigidly locking the tailstock barrel and clamping the spindle.

The bed is of a special anvil section, with broad slides for the carriage and bearings for the head and tailstock, and is strongly ribbed internally and mounted on a cabinet base, in which the pan and chamber for cutting compound is cast. The pan becomes an integral part of the bed, and greatly stiffens the entire machine. A strainer separates the chips from the cutting compound, which flows back to the base of the machine. A geared rotary pump and piping for circulating the compound is supplied as regular equipment.

A cover plate is provided for cleaning out the base.

The carriage is a broad slide extending practically the full length of the bed and scraped to a bearing its entire length. The cross slide for mounting the compound or plain rest is massive and cast integral with the carriage. The head and tailstock are located and carried by the rear shear permitting the carriage to travel past them and keep the slides continuously covered.

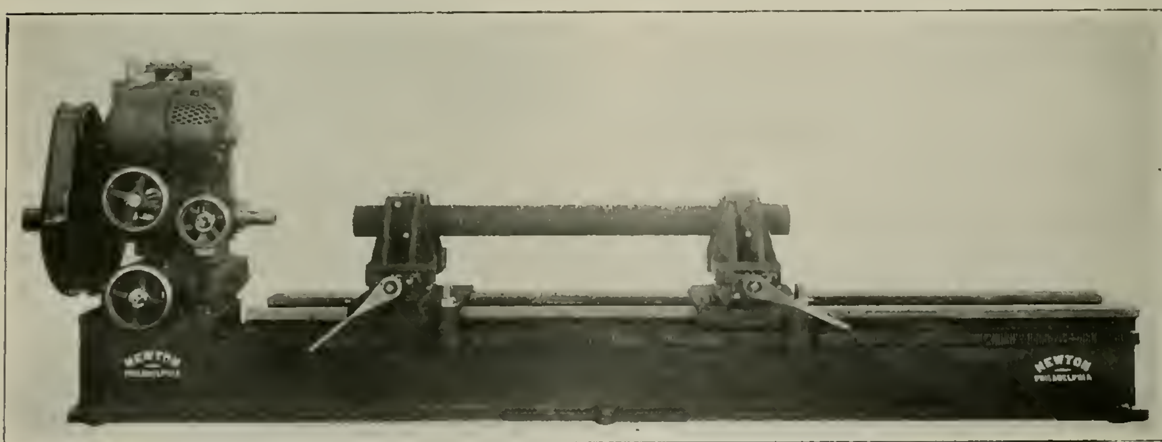
The Multi-Cut lathe is built in two sizes, No. 6, 6-in. swing, 10-in. capacity between centers, and No. 9, 9-in. swing, 16-in. capacity between centers. Several types of headstocks are supplied for each machine.

Some of the headstocks may be motor driven. The motor is attached to a motor plate hinged from the cabinet base of the machine and provided with an adjustable jack for maintaining the desired belt tension.

A constant speed motor A.C. or D.C. running preferably 1,200 r.p.m. is recommended.

NEWTON CENTERING MACHINE

The centering machine shown in the illustration is a recent development of the Newton Machine Tool Works, Philadelphia, Pa. It is designed for centering rough and irregular castings. The spindle is of forged steel 3 in. in diameter, running in bronze bushed bearings and having an 8-in. horizontal hand feed. The maximum distance from the center of the spindle to the top of the base is 17½ in. and the minimum distance 13½ in., giving a vertical adjustment of 4 in. The spindle also has a cross adjustment of 4 in., equally divided each side of the center line of the work. Two universal centering vises of the interlocking type and adjustable on the bed are supplied with the machine. The jaws are adjustable by means of a screw giving a capacity for stock from 2 in. to 12 in. in diameter and of any desired length. The alinement of all of the movable parts is maintained by adjustable tapered shoes. The drive is by direct connected motor through bronze driving gear. The base of this machine is 22 in. wide and 16 ft. long.



The Newton Centering Machine with Round Stock in the Vises

Machine Tools in France.—Before the war the majority of machines imported into France came from Germany. In 1913, France imported 28,000 machine tools at a value of 52,000,000 francs, 50 per cent of which came from Germany. During the same year 11,000 machine tools, valued at 16,000,000 francs, were exported from France. Machine tools to the value of 65,000,000 francs were produced in France in 1913. It is planned that the French aeroplane factories will be converted into plants for the manufacture of machine tools.—*Le Génie Civil.*

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WE GUARANTEE, that of this issue 11,100 copies were printed; that of these 11,100 copies 10,341 were mailed to regular paid subscribers, 20 were provided for counter and news company sales, 213 were mailed to advertisers, 29 were mailed to employees and correspondents, and 497 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 95,710, an average of 9,571 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The Seaboard Air Line has decided to use oil fuel in the locomotives on its lines south of Hamlet, N. C., and has contracted for a supply of oil from Mexico.

A plan for preventing strikes, similar to that embodied in the Canadian law, is provided in a bill, H. R. 9062, introduced in Congress by Representative Wood of Indiana. It provides for the appointment by the President of commissions to investigate labor controversies and would prohibit a strike or lockout pending the conclusion of any investigation by a commission.

The Central Railway Club's annual outing at Grand Island, N. Y., on August 28, was voted one of the most enjoyable in the history of the organization by the 160 members who attended. A brief business session was held, during which announcement was made that the campaign for a membership of 1,000 has been progressing so well that only about 100 more are required to bring the membership list up to the desired number.

Dr. John D. Robertson, health commissioner of the city of Chicago and head of the Smoke Prevention Bureau, recently declared, in connection with a smoke prevention drive he is now conducting, that smoke from locomotives in the city of Chicago must be eliminated. A recent newspaper statement quotes him as saying: "I don't care how the railroads end the smoke nuisance. They can use smokeless coal, change their boilers or do anything they desire, but the smoking engines must stop. No excuses will go." Railway executives, master mechanics, and locomotive firemen and engineers were called into conference in Doctor Robertson's office and plans were formulated for reducing the smoke nuisance insofar as the railroads entering Chicago are concerned.

A delegation representing the railroad shopmen recently called upon Governor J. P. Goodrich of Indiana and urged the establishment of a state mediation committee to investigate strikes and threatened strikes before calling out state troops "unnecessarily." It was pointed out that great expense could have been saved the state had troops not been sent to Hammond, Ind., to end the recent disorders resulting from the strike of employees at the plant of the Standard Steel Car Company. This contention, however, was not concurred in by the governor, who acted without hesitation when local authorities at Hammond admitted their inability to preserve order. Governor Goodrich has taken the matter under advisement and will hold further conferences with the shopmen's representatives.

Arbitration Rules

The Arbitration Committee of the Mechanical Section of the American Railroad Association, calling attention to requests for interpretations and for arbitrations that are not prepared in accordance with the rules, promulgates the following general rules:

1. Requests for interpretation of the Rules of Interchange must be signed personally by the chief mechanical officer of the railroad or company. Questions received from car foremen, bill clerks, inspectors and others in a minor capacity, will not be considered. Many of the questions raised by these minor officers could and would be settled by the chief mechanical officer without being referred to the arbitration committee.
2. In presenting requests for interpretation, all facts in the case should be clearly stated, and, wherever possible, repair cards and other records involved should accompany the letter.
3. Where the question for interpretation is the result of a controversy with another company, the name of the other company should be given in order that the committee may, if necessary, request additional information from both parties to the dispute. Several requests for interpretation of the rules have been presented recently that were in reality disputes that should have been prepared as arbitration cases.
4. All cases presented for arbitration should be prepared in accordance with provisions of Interchange Rule 123. Both parties to the dispute should join in presenting the case. The entire file, including original repair cards, joint evidence certificates, etc., should accompany the prepared statements.

Safety Appliances and Loading Rules

The Interstate Commerce Commission has extended the effective date of its latest order requiring the railroads to make their freight cars conform to its standards of safety appliance equipment, from September 1, 1919, to March 1, 1920. This was done at the request of the Railroad Administration and the American Railroad Association.

The Mechanical Section of the American Railroad Association has therefore changed the effective date of sections G and K of Rule 3 of the 1918 Code of the Rules of Interchange from September 1, 1919, to March 1, 1920. A correction has also been made in Supplement No. 1 to the loading rules. In Figs. 42 and 46, accompanying this supplement, half-inch bolts are shown passing vertically through the ends of the clamping pieces to prevent splitting. These bolts should be applied horizontally instead of vertically, as shown in the drawings.

American Society for Testing Materials

Society headquarters have been established by this association at the Engineers' Club building, 1316 Spruce street, Philadelphia, Pa. Offices were heretofore at the University of Pennsylvania.

The membership of the society has passed the 2,500 mark, now numbering 2,538. While the growth of the society has been steady, it has never been as rapid as during the present year, during the first eight months of which 313 new members were enrolled.

In accordance with the policy inaugurated in 1917 the tentative standards of the society will be published in Part I of the proceedings, and will also be published in a separate volume for the convenience of those who may wish to use them in that form. The 1919 edition will contain the 62 specifications, tests, methods and definitions which have been accepted by the society as tentative, of which 23 are new this year and nine have been revised. This volume will comprise about 350 pages, and is expected to be available for distribution in November, about a month earlier than the proceedings.

Conditions Affecting Trade with Siberia

Numerous inquiries have been received in Washington regarding the conditions and regulations surrounding trade with Siberia. In order to clear up certain misapprehensions regarding trade with this region the following notes have been compiled by the Foreign Trade Advisers' Office of the Department of State.

The so-called Allied Purchasing Committee, of which Capt. George E. Spengler is chairman, is a subcommittee of the Interallied Technical Board of the Committee for Supervision of the Chinese Eastern and Transsiberian Railways. This committee will make purchases of supplies and materials for the Siberian railways by direction of John F. Stevens, president of the Technical Board of the Interallied Committee. All orders for material to be purchased in the United States for use in connection with the railways will be placed by the committee through the Director General of Military Railways, War Department. This committee has nothing to do with purchases of other than railway material and supplies. The Director General of Military Railways is in close touch with all American manufacturers and is in a position to expedite orders for badly needed supplies.

Equipment Conditions on Russian Railways

In January, 1916, there were still 72,743, and in January, 1917, 70,118 freight cars, running daily; in January, 1918, this number had decreased to 16,644, and in January, 1919, it had sunk to 13,193 cars. The working capacity of the engines has fallen off in a similar degree. In 1918 they were capable of travelling only about 35 miles per day. The workshops were obliged to hand over important parts of their machinery to the munition workshops. This absence of necessary machinery and instruments is especially felt in the locomotive shops. The number of railway engines out of repair amounted in March, 1916, to 17.3 per cent; March, 1917, 23 per cent; March, 1918, 35.3 per cent; March, 1919, 52.4 per cent. The number of freight cars out repair amounted in March, 1916, to 3.4 per cent; March, 1917, to 5.4 per cent; March, 1918, to 9.1 per cent; March, 1919, to 18.8 per cent.

The railway bridges and railway lines are also in a state of decay and have in some cases been badly damaged as a result of civil war. Little is heard in the press of the numerous accidents that take place in consequence of trains running off the lines. The work of repair is often hindered by the passive resistance of railway workers antagonistic to the Soviet regime. For lack of raw material, the number of engines built in 1918 was considerably reduced. In 1917, 520 locomotives were able to be built in Russian foundries, but only 191 in 1918, 152 of which were intended for goods traffic, and only 39 for passenger trains. Since the taking of the Urals by Kolchak's army, the production of pig-iron for rails has entirely ceased as far as the requirements of Soviet Russia are concerned and few new lines can be built.

Lack of Railroad Facilities Hampers All Eastern Europe

"Transportation is the chief difficulty alike in relief work and reconstruction throughout eastern Europe. Adequate railways in the Balkan States would unlock great natural resources and open up endless possibilities. The next decade in this part of the world must be an era of railroad building if the people are to live and prosper."

This paragraph, quoted from the monthly report of the American Red Cross mission at Bucharest, says a correspondent to the Philadelphia Public Ledger, points out the most serious problem which faces the new governments of the countries of eastern Europe. There are at present fewer than 100 trains in the whole of Rumania and no more than 400 locomotives, counting every available engine—good, bad and indifferent.

The most luxurious train in Rumania today includes one first-class coach and three coaches of a nondescript third-class type. Thousands of men are at work repairing the lines, but their work is hampered by lack of material. Bridges by the score were destroyed during the war by both Rumanians and Germans. These have been repaired in part only. Trains in Rumania creep along at one-third the old-time speed, with peasants and other travelers riding wherever they can find foot room, either on the steps of the coaches, on the couplers or on the roof.

As a rule, about 50 persons are accommodated on the roof of each coach. This is fine enough in fair weather, until the train pulls into a tunnel, when the roof-riders and those on the steps are half asphyxiated by the thick black coal smoke that pours from the locomotive. The locomotives used fuel oil before the war, Rumania being an oil-producing country; but the Germans took away all the oil burners from the engine fire-boxes and the locomotives have to get along now as best they can with whatever fuel is available.

It is reported in Berne that more than 50 German and American locomotives will shortly be sent from France through Switzerland to Rumania and Poland to supply the urgent need for engines in those countries. Rumanian en-

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Oct. 14			W. A. Booth	131 Charron Street, Montreal, Que.
Central	Nov. 13	Annual dinner		H. D. Vought	95 Liberty Street, New York.
Cincinnati	Nov. 11	Annual banquet and entertainment		H. Boutet	201 Carew Building, Cincinnati, Ohio.
New England	Oct. 14	Shop Efficiency	Frank McManamy	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Oct. 17	Utilization of Freight Cars	W. C. Kendall	H. D. Vought	95 Liberty Street, New York.
Pittsburgh	Oct. 23	Annual meeting and election of officers		J. D. Conway	515 Grandview Avenue, Pittsburgh, Pa.
St. Louis	Oct. 10	Can the Railway Problem Be Solved?	S. O. Dunn	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Oct. 20	Design, Inspection and Maintenance of Freight Car Equipment	L. K. Sillcox	J. M Byrne	547 West Jackson Blvd., Chicago.

gine drivers have already arrived in France (says a (London) Times correspondent) to take charge of some of these locomotives.

Shortage of German Rolling Stock

The Technical Supplement to the Review of the Foreign Press (London) publishes an extract from the Kolnische Zeitung of June 15, giving an account of the causes for the shortage of German rolling stock.

"In the Ruhr district there are renewed complaints as to the 'shortage of wagons.' This expression is generally used to express a state of things for which it is not really appropriate. There seems rather to be a shortage of locomotives to bring the wagons to the places where they are required than a shortage of wagons themselves. The terms of the armistice, requiring the surrender of so many locomotives, are responsible for this.

"The Prussian Railway Administration meanwhile has given orders for 2,463 new locomotives, and the engine works are doing their best to deliver them. On the whole they have executed the orders satisfactorily. The reason why the stock of locomotives is not increasing is explained by the bad condition of the old engines, the result being that every week as many come to be repaired as have been sent out from the repair shops. There is an incontestable shortage of passenger carriages. The Railway Administration has consequently ordered 2,896 coaches and 45,000 freight cars. The total orders given amount to 2,000,000,000 marks. But even by these orders the stock of locomotives and wagons is brought to its proper level, the whole difficulty is by no means solved. There is not a trained personnel available to enable such a stock of wagons to be utilized as fully as necessary. This problem is rendered more acute by the eight-hour day difficulty, while the abolition of piece-work delays the repairs to the rolling stock. Then there are the constant interruptions to work by elections, meetings and councils. The unsatisfactory state of things in the railway world is another of the 'achievements' of the revolution."

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meeting, and places of meeting of mechanical associations:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Association, Section III—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawler Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, secretary, Federal Reserve Bank Bldg., St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

Chief Interchange Car Inspectors' and Car Foremen's Association.—H. J. Smith, D. L. & W., Scranton, Pa.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car and Locomotive Painters' Association of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association. J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association. W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

GENERAL

W. P. Christie has been appointed superintendent of safety of the Toledo, St. Louis & Western, with headquarters at Frankfort, Ind., succeeding F. E. Myers, resigned.

William D. Hannah, chief fuel inspector of the Grand Trunk, with headquarters at Montreal, Que., has retired after 40 years of continuous service with that road.

A. H. Kendall has been appointed master mechanic of the Quebec district of the Canadian Pacific, with office at Montreal, Canada, succeeding C. A. Wheeler, transferred

R. W. Lipscomb, assistant superintendent on the Galveston, Harrisburg & San Antonio, at El Paso, Texas, has been appointed chief assistant mechanical superintendent on the Southern Pacific Louisiana Lines and Texas Lines, with headquarters at Houston, Texas, succeeding J. P. Nolan, retired on pension.

J. J. Maginn, formerly master mechanic of the Cincinnati Northern at Van Wert, Ohio, has been appointed superintendent of motive power of the Lake Erie & Western, with headquarters at Lima, Ohio, succeeding George J. Duffey, deceased.

CAR DEPARTMENT

C. J. Nelson has been appointed general foreman of the car department on the Chicago & North Western, in charge of the Galena and Wisconsin divisions and Chicago Terminals, succeding L. R. Wink.

L. R. Wink, general foreman of the car department on the Chicago & North Western, has been appointed assistant superintendent of the car department, with offices at Chicago.

SHOP AND ENGINEHOUSE

L. B. Shearer has been appointed tank shop foreman of the Erie Railroad at Huntington, Ind., succeeding J. E. Shavey, transferred.

PURCHASING AND STOREKEEPING

F. A. Hamilton has been appointed purchasing agent of the Colorado Springs & Cripple Creek District Railway, with headquarters at Colorado Springs, Colo.

T. C. Hopkins has been appointed local storekeeper of the Baltimore & Ohio at Cleveland, Ohio, succeeding L. F. Ryan, resigned.

J. A. Laughlin, storekeeper of the New York Central, Lines West of Buffalo, at Elkhart, Ind., has been appointed an assistant general storekeeper at Collinwood, Ohio.

W. A. Miller has been appoinated division storekeeper on the Southern Railroad, with office at Spencer, N. C., succeeding C. J. Norman, deceased.

Henry Stephens has been appointed an assistant general storekeeper on the New York Central, Lines West of Buffalo, with headquarters at Collinwood, Ohio.

OBITUARY

Edward Salley, supervisor of locomotive operation on the New York division of the Erie Railroad, died on August 13 at his home in Jersey City, N. J., at the age of 74. Mr. Salley had been in the employ of the Erie for more than 50 years, for the past 15 years as supervisor of locomotive operation.

SUPPLY TRADE NOTES

Richard Pintsch, inventor of the Pintsch gas lighting system, is reported to have died recently at Berlin, Germany, at the age of 80.

The American Locomotive Company is planning to carry out improvements to double the capacity of its steel plant at Chester, Pa. The work will cost about $1,000,000.

The Hutchins Car Roofing Company, Chicago, has opened an office in the Railway Exchange building, St. Louis, Mo., in charge of Charles F. Pace as district sales manager.

S. B. Andrews has resigned as mechanical engineer of the Seaboard Air Line at Portsmouth, Va., and has been elected vice-president and general manager of the Union Iron Works, Inc., Berkley-Norfolk, Va.

George A. Cooper, of the sales and advertising department of the United States Graphite Company, Saginaw, Mich., has been appointed advertising and export manager of the Detroit Lubricator Company, Detroit, Mich.

Paul Mitchell has resumed his duties as traveling representative of the Chicago sales office of the Independent Pneumatic Tool Company, Chicago. Mr. Mitchell was a sergeant in the American Expeditionary Forces in France.

H. W. Johns-Manville Company, New York, has commenced excavating for a large plant at Waukegan, Ill. No contracts have been let for the building itself as the type of construction and the specifications have not been fully decided upon.

E. M. Cutting, Pacific coast manager for the Edison Storage Battery Company, with office at San Francisco, Cal., has been appointed manager of the railroad department with office at Orange, N. J. Mr. Cutting entered railway work in 1888 in the signal department of the Southern Pacific. In 1898 he was appointed supervisor of signals for the Western division and in 1902, in addition to his duties in the signal department, he was given charge of all electric train lighting. In 1908 he became engineer of train lighting, heating and ventilation, resigning in 1912 to become Pacific coast manager for the Edison Storage Battery Company, which position he held until his recent promotion. Mr. Cutting was instrumental in initiating the movement which culminated in the formation of the Association of Railway Electrical Engineers, of which he was elected president in 1909.


E. M. Cutting

D. B. Fulton, assistant to the chief engineer of the American Brake Shoe & Foundry Company, New York, has entered the sales department of the Railway Steel Spring Company, Chicago, where he will be associated with N. C. Naylor, sales agent in the Chicago office.

The Carborundum Company, Niagara Falls, N. Y., has opened a branch office and warehouse in the Burkhardt building at Second and Larned streets, Detroit, Mich. This branch is under the management of Anthony Dobson, who will have charge of the Detroit sales district.

The Pollak Steel Company, Cincinnati, Ohio, has appointed the Lake Shore Engine Works, Marquette, Mich., as its agent for the upper peninsula of Michigan, and the E. R. Hensel Steel & Copper Company, Security building, St. Louis, Mo., agents for the St. Louis district.

George W. Bender, district manager in charge of the New York office of Mudge & Co., Chicago, has been promoted to manager of sales and service with headquarters in Chicago. Mr. Bender was born at Pittsburgh, Pa., on August 20, 1884. At the age of 17, he entered the engineering department of the Pressed Steel Car Company of that city. In 1906, he accepted a position with the American Locomotive Company, where he had charge of the extra work order department. In 1910 he became associated with Mudge & Co. as chief draftsman, and subsequently was given charge of the mechanical department. Later he was made assistant to the vice-president, a position he held until his appointment in April, 1918, as eastern manager in the New England and Atlantic Coast states, in which capacity he served until his recent promotion.


George W. Bender

Paul Sutcliffe, advertising manager of the Edison Storage Battery Company, Orange, N. J., has been appointed manager of the industrial truck and tractor department of the same company. Mr. Sutcliffe has been with the Edison Storage Battery Company for the past five years.

The Bucyrus Company, South Milwaukee, Wis., announces that it has opened a Cleveland office at 808 American Trust building in charge of E. G. Lewis, formerly with the New York office of the Bucyrus Company and more recently president of the New Jersey Slag Products Company, of Dover, N. J.

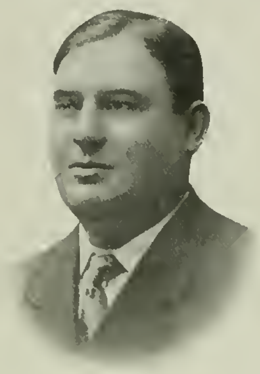
The Chicago Pneumatic Tool Company, Chicago, has removed its Cincinnati (Ohio) office from the Mercantile Library building to the Walsh building, Pearl and Vine streets, where a service station with a complete stock of pneumatic tools, electric tools, air compressors, oil engines, rock drills and repair parts will be maintained.

E. G. Buckwell, secretary and manager of sales of the Cleveland Twist Drill Company, Cleveland, Ohio, has recently returned from a three-months' visit to England and the Continent, where he has made a thorough trade investigation in conjunction with the Cleveland Twist Drill Company of Great Britain, Ltd., London, the European branch of the Cleveland Twist Drill Company.

John D. Rogers has received his discharge as captain of engineers in the office of the director general of military railways in Washington, D. C., and is now in the foreign sales department of the Baldwin Locomotive Works at Philadelphia. Prior to entering the army, Mr. Rogers was shop superintendent on the Virginian Railroad, having previously served on the Chesapeake & Ohio, the Pere Marquette, and the Union Pacific railroads.

Charles Riddell has resumed his duties as manager of the Chicago office of the Baldwin Locomotive Works and the Standard Steel Works Company. Mr. Riddell, who was formerly manager of the Chicago office, has been serving as assistant secretary and treasurer in the financial department at the Philadelphia, Pa., office for the past year and a half. Arthur S. Goble, manager of the Chicago office of the Baldwin Locomotive Works, has been transferred to the St. Louis, Mo., office.

John Kelly, who for a number of years was New York district manager of the Edison Storage Battery Company, has been appointed general sales manager of the company, with headquarters at Orange, N. J. This promotion for Mr. Kelly follows closely upon his promotion, on July 1 of this year, to the position of assistant general sales manager. Mr. Kelly brings to his new position the experience of a long and varied career in the storage battery, electric vehicle and accessory business. For nine and one-half years he was district manager of the New York office of the Edison Storage Battery Company. Before that he had been a salesman for the Westinghouse Storage Battery Company for two years, for the Swinehart Tire & Rubber Company for three years, for the Firestone Tire & Rubber Company for two years, and for the New York Edison Company for nearly four years.



John Kelly

Major H. C. Bayless, formerly mechanical engineer on the Minneapolis, St. Paul & Sault Ste. Marie and the Great Northern, but more recently chief inspector of ordnance for the War Department at the Standard Steel Car Company's plant at Hammond, Ind., has been appointed combustion engineer and manager of the Superior Pulverizer Company, Chicago, in which capacity he will have entire charge of engineering and sales and general supervision of coal installations.

The Fastfeed Drill & Tool Corporation, recently incorporated under the laws of the state of New York with an authorized capital of $500,000, has purchased the factory, together with the business and good will, of the McCarthy Drill & Tool Corporation, Toledo, Ohio. John D. McGrath, formerly treasurer of the McCarthy Drill & Tool Corporation, is managing director of the new organization, which will continue to operate the plant in Toledo. Additions to the present equipment are planned for the near future.

F. H. Crawford, sales manager of F. H. Niles & Co., Inc., Woolworth building, New York, has been appointed secretary, and J. E. Haetten, assistant sales manager has been appointed sales manager. G. P. Goodman, who for several years has represented the Hisey-Wolf Machine Company, Cincinnati, Ohio, in the east, becomes associated with the F. H. Niles & Co., Inc., having charge of its portable tool department. This company handles in the east the Hisey-Wolf line of electric machine tools, and the Canton pneumatic hammers and drills made by the Pittsburgh Pneumatic Company, Canton, Ohio.

The Baldwin Locomotive Works and the Standard Steel Works Company have opened a branch office in the Merchants National Bank building, St. Paul, Minn. Henry Blanchard, sales representative in the Chicago office of the concerns, has been appointed manager of the new branch offices. Mr. Blanchard entered the service of the Baldwin Locomotive Works and the Standard Steel Works Company in the latter part of 1915, in the Philadelphia office. In April, 1919, he resigned as assistant to the vice-president in the Philadelphia office and was transferred to the Chicago office as sales representative. Prior to entering the service of these companies he served as sales engineer of the American Steel Foundries, with office in Chicago.

The Electrolytic Oxy-Hydrogen Laboratories, Inc., announce the formation of a sales and manufacturing company under the name of the Electrolabs Company. The Electrolytic Oxy-Hydrogen Laboratories, Inc., will continue in charge of the laboratories and maintain a technical supervision over the work of the new company. The general offices and works of both companies have been moved from Dayton, Ohio, into larger quarters at 2635 Penn avenue, Pittsburgh, Pa. The general sales offices are being continued at 15 William street, New York City, and branch sales offices have been opened in the Morris building, Philadelphia, and in the Merchants Exchange building, San Francisco. I. H. Levin continues in charge of technical and research work, and D. J. Tonkonogy in general charge of sales.

John F. Schurch, operating vice-president of the T. H. Symington Company Lincoln Park Works, Rochester, N. Y., has been elected vice-president in charge of all western sales, with headquarters in Chicago. Mr. Schurch graduated from the University of Minnesota in 1893. He entered the service of the Minneapolis, St. Paul & Sault Ste. Marie the same year, serving consecutively in the office of the auditor, and of the general superintendent and in the transportation departments, resigning in 1905 after obtaining the position of chief clerk to the vice-president. From 1905 until 1914 he was associated with the Railway Materials Company of Chicago. In February, 1914, he was elected vice-president of the Damascus Brake Beam Company with office in Cleveland, Ohio, and in June, 1914, he was elected president of that company, which position he resigned the same year and was elected vice-president in executive charge, under President C. H. Symington, of the Symington interests in the production of 75 mm. guns, shells and forgings. The Symington interests included the Symington Anderson Company, the Symington Machine Corporation, the Symington Forge Corporation, with office in Rochester, N. Y., and the Symington Chicago Corporation, with office in Chicago. In August, 1918, in addition to these offices, he was made operating vice-president of the T. H. Symington Lincoln Park Works. Mr. Schurch is also vice-president of the Railway Supply Manufacturers' Asociation.

J. F. Schurch

CATALOGUES

Data on Shafts.—Three charts giving the relations for any shaft between power, shaft diameter, torsional stress and speed have been prepared by one of the engineers of the Wellman-Seaver-Morgan Company, Cleveland, Ohio, which has published them in bulletin No. 22 for the use of engineers and draftsmen.

Color Chart for Heating Steel.—The Onondaga Steel Company, Syracuse, N. Y., has prepared a graphic color chart containing directions for cutting "ON" high speed steel for tool lengths, for forging and hardening forged tools, milling cutters and finished tools, and for tempering and annealing, with the temperatures for the different operations shown in color.

Steam Motor.—A description of its steam motor is given in bulletin No. 5, issued by the Steam Motors Company, Springfield, Mass. The bulletin contains 23 pages of descriptive material and many illustrations showing the parts and construction of the motor and the method of its application. The motor is a steam turbine designed for use in direct connected centrifugal pump and blower units.

Machine Tool Equipment.—A number of two-page bulletins have been issued by the Bilton Machine Tool Company, Bridgeport, Conn. These bulletins are bound in a cover with punched holes to which others may be added from time to time and each briefly describes and illustrates a machine made by this company. These include gear milling and hobbing machines, automatic milling machines, automatic cam feed drill presses, drilling and riveting machines, etc.

Fans, Blowers and Exhausters.—The various types of blowers, exhausters and fans manufactured by the Buffalo Forge Company, Buffalo, N. Y., are described in catalogue No. 400, with illustrations and tables of specifications. Diagrams and illustrations of countershafts designed for use with these blowers and exhausters are shown, together with dimensions and price lists. This booklet, consisting of 35 pages, contains information of special value to fan users.

Leather Belting.—A 20-page pamphlet issued by the Leather Belting Exchange, Philadelphia, Pa., contains information obtained during the course of an investigation on power transmission by belting conducted by the Mellon Institute of Industrial Research of the University of Pittsburgh for the Leather Belting Exchange. The booklet is entitled "A Study of Various Types of Belting," and was written by Professor Ernest D. Wilson of the Mellon Institute. It describes the equipment used in the tests and the results obtained, and is illustrated with several photographs.

Boiler Feed Control.—An eight-page bulletin, embodying specifications for the Copes system of boiler feed regulation, has been published by the Northern Equipment Company, Erie, Pa. A cover is provided with punched holes for adding future bulletins or specifications that will be published by the company. The bulletin discusses the principle and operation of the regulator and its mechanical construction, heat storage, reduction of furnace temperature fluctuations on sudden load changes, service performance, and the Copes steam pump governor. It contains a number of charts and photographs.

Steam Jet Air Pumps.—Preliminary bulletin No. 113, illustrating and describing the Wheeler steam jet air pump is now being distributed by the Wheeler Condenser & Engineering Company, Carteret, N. J. This steam jet air pump has two or more steam jets working in series with a condenser between the jets, which permits more efficient operation. The pump is applicable to jet condensers, as well as to surface condensers. The bulletin explains the operating principles, gives reasons for high efficiency, describes the inter-condenser and shows an operating test curve. It includes a cross sectional drawing and shows how to connect double machines or triple machines to surface condensers.

Pneumatic Tools.—In a temporary catalogue, containing 48 pages, issued pending the publication of a larger book, the Keller Pneumatic Tool Company, Grand Haven, Mich., shows briefly its line of pneumatic tools, including valve and valveless types of rotary and piston drills, which are new additions to the line. All models of Keller-Made Master-Built chipping hammers, riveting hammers, holders-on, dolly bars, jam riveters and sand rammers are illustrated and described, with detailed specifications and information as to the uses for which each is designed. This company has also published a four-page folder containing a list of their special tool making and production equipment, with a few illustrations of representative operations and productions.

Electric Furnaces.—Booklet 5-B, published by the Electric Furnace Company, Alliance, Ohio, is an attractive 24-page catalogue describing the Baily types of electric furnaces for melting non-ferrous metals. These types embrace pusher type continuous furnaces for heating and annealing steel, copper, brass and aluminum, automatic control type continuous furnaces for heat treating steel castings and forgings, and car type furnaces for annealing steel, copper, brass and aluminum, and have electrical capacities of from 150 kw. to 1,500 kw., and furnace capacities of 1,000 lb. to 10 tons per hour. These furnaces are all of the resistance type and have several distinct features. The booklet contains illustrations of a number of actual installations and records of tests made with the equipment in several industrial plants.

Automatic Cut-Off Valves.—The Lagonda Manufacturing Company, Springfield, Ohio, in catalogue S-2 describes the Lagonda automatic cut-off valves for power plants, which are designed to close automatically in case of an abnormal flow of steam in either direction through the valve. The booklet contains an account of tests made by the Department of Commerce of the United States to determine their reliability of operation and adaptability for different conditions. External dashpot valves for use when the flow of steam from boilers to the header is practically constant, and internal dashpot valves for installation where load conditions are unsteady are fully described, with illustrations showing sectional views of the various classes of valves. Lagonda non-return valves which close in case of tube rupture or an accident to the boiler are also covered in the catalogue, which contains 32 pages.

Fuel Oil.—This is the title of a 46-page booklet published by the Tidewater Oil Company, New York, which gives a brief survey of experiences of various users of fuel oil and gas oil, and is intended to be of service not only to non-technical executives and plant managers, but also to plant engineers. It contains many charts, diagrams and illustrations and is divided into 15 chapters. The following chapter headings will give some idea of its contents: Advantages of Fuel Oil over Coal; the Nature and Refining of Crude Oil; Greater Economy of Heavy over Light Fuel Oils; Results Obtained Where Fuel has been Changed from Coal to Oil; Installation, Burner and Furnace Requirements. Under the heading Estimating the Saving, Fuel Oil Vs. Coal, a formula is given for computing roughly the amount which a particular plant can afford to pay for oil as computed from the present price of coal firing.

Railway Mechanical Engineer

Volume 93 November, 1919 Issued December 12, 1919 No. 11

CONTENTS

CAN YOU WRITE A GOOD STORY?

Does the romance in the day's work appeal to you?

Do you take a keen interest in the study of human nature?

From your personal experience have you a clear vision of some of the unsolved problems in the motive power or car departments? Better yet, have you some ideas of your own as to what might be done to improve supervision, put production on a better basis, or take the kinks out of the organization?

If you can answer "Yes" to these four questions, or even to the first three of them, would you like to give expression to your conception of the unsolved problems of the department, or to your ideas for their solution, in the form of a story with the shop, roundhouse, repair yard or office as the scene, and the characters those with whose qualities you have become so well acquainted by daily contact in the conduct of your part in the game of railroading?

For the three best stories received at our office in the Woolworth Building, New York, on or before April 1, 1920, we offer a first, second and third prize of $75, $50 and $25 respectively. All stories accepted for publication will be paid for on acceptance at our regular space rates and any received in time will be published in the issues intervening before the contest closes. After the competition closes those to whom the prizes are awarded will receive the prize in addition to the amount paid for the story at space rates. Although there are no conditions other than those already mentioned, it is suggested that a good story of this kind can probably be told within the limits of 1,200 to 2,500 words.

In judging the relative merits of the stories submitted and selecting the prize winners we shall, of course, give some attention to the use of English and the literary finish. But do not be unduly concerned by this fact, for we shall give far more weight to the theme of the story, the quality of the plot, the ability to reproduce the atmosphere of the surroundings, the truth of the character portrayal and the naturalness with which the plot is developed.

Try it and see how it goes.

Why Your Copy Is Late

Because of labor difficulties the publication of the October and November issues of the *Railway Mechanical Engineer* has been greatly delayed. The October issue was held up when it was practically ready for mailing and work was not resumed for two months. The difficulties have now been settled and all the issues will be brought out as quickly as possible. It is expected that the usual schedule will be resumed within a few weeks. In the meantime we must ask the indulgence of our readers if they do not receive their copies promptly.

Economy and the Test Department

The high cost of labor and of the materials needed in railroad work makes it imperative that nothing be left undone that will tend toward economy of operation. A most important adjunct to the modern railroad organization is the test department, and if it is given the wholehearted co-operation of both the managing and the operating officials it can do most effective work. Too often the cost of making a test is allowed to stand in the way of securing data that would mean a lasting improvement in the operation of the locomotive or some other part of the equipment. This is a short-sighted policy —one that is penny wise and pound foolish. Frequently a saving effected in material or an increase in the efficiency of some particular part of the railroad equipment is due entirely to the work of the test department, and these improvements, if given proper attention by those charged with the daily operations, will produce lasting results. It is a noticeable fact that those railroads having the most active test departments are usually the most efficient. Give the test department an adequate force of engineers and the proper co-operation, and beneficial results will surely follow.

Injustice to Helpers and Apprentices

That portion of the shopmen's new agreement with the Railroad Administration which affects the car shop stipulates that in certain cases helpers or apprentices who have served two or more years may be promoted to mechanic with a mechanic's rate of pay. This is very good and an incentive to good work on the part of a helper or apprentice. Another clause of the agreement, however, provides that if a mechanic having had four or more years' experience applies for work, the helper or apprentice so promoted must be demoted and the mechanic put at work. This is an injustice to the demoted helper and apprentice and is certain to become a source of dissatisfaction. This rule applied, as it evidently is intended to be, may cause the demotion or even discharge of good workers, who may perhaps have homes in the vicinity of the shop in question, to make a place for itinerant mechanics who shift about from shop to shop, and in actual service rendered are not equal in value to a good helper or apprentice. This rule should be given further consideration and changes made so that there may be some discretion on the part of the shop officials as to the demotion of any helper or apprentice under such circumstances.

Development of Shop Foremen

A vital factor in an efficient shop organization is the staff of foremen, and their selection must be given more careful consideration than has been the case in the past. Under the conditions which prevailed in the industrial world until recent years the foreman did not occupy a position of great responsibility, except as he was directly concerned in the work turned out by his department. The foreman was usually selected for his own ability to perform the manual tasks of his craft and so judged as being qualified to direct others. Where the organization was a small one and the superintendent or owner in close touch with the men this practice served very well. But with the expansion of industries this intimate contact has been lost and the shop foremen have become a very vital cog in the organization wheel. The ideal foreman of the present is one who not only is proficient in his craft, but who has the tact necessary to smooth out diplomatically the friction resulting from the real or fancied grievances of the workers. In short, the modern foreman must not only direct the work of his subordinates, but must also act as an intermediary between employer and employee, and this last is a quality that must be brought to the fore if the lion and lamb—employer and employee—are ever to lie down together peacefully.

This condition applies just as much to the railroads as to industries in general and with the return of the roads to private operation the need for foremen of high calibre will become more pressing. While the selection of foremen is given careful consideration on many railroads, most roads make practically no attempt to train men for such positions. Would not a training school conducted along the lines of the officers' training camps, which gave such splendid results in the rapid development of the American army, be a long step toward the solution of the foreman problem? It would be quite possible for a number of the larger railroads to conduct such schools within their own organizations, but for the greater number of railroads this would be impracticable and the benefits to be derived, by the larger as well as the smaller roads, would be much greater in a general training school. To this school might be sent not only men who gave promise of developing into competent foremen, but also those men already occupying the position of foreman. Many of the latter would benefit, by the close contact with others in similar positions, to an extent that is not possible in conventions of the foremen's organizations now in existence. Further, the incentive given to young men in the shops to qualify for a term in such a school and a place on a foremen reserve list would result in more efficient work by the individual and consequently a more efficient shop as a whole.

The plan would involve a general training school supported by the railroads pro rata; men detailed to the school on the basis of shop performance and a foreman's reserve list. The results would be felt in increased efficiency and would insure a source of qualified men for positions of authority.

Paint the Steel Cars

The poor condition of great numbers of steel cars, particularly gondola and hopper cars, is very apparent, as may be seen in any railroad yard, and not the least of the defects is the lack of paint. Recent observations of such cars in various parts of the country showed a large number to be scaled so badly that it was possible to pick off great patches of the paint with the hand. The steel plate underneath paint scaling in this manner is so rusted that it is a question of only a short time before such cars will be useless without extensive repairs to the car body. This condition at the present time is partly due to the necessity of keeping this class of car—used largely for coal—in service, but there is a limit beyond which this is not justifiable. There has been considerable difference of opinion among railroad master painters as to the best method of painting such cars, but it is obvious that the progress of decay—rust—must be stopped and the steel protected from further injury by the elements. If no better method can be found, the surface should be thoroughly cleaned by a sand blast, using a fine screened sand gravel, and then given a priming coat and a finish coat of a good linseed oil paint. Various substitutes for linseed oil have been tried and found wanting. There has also been much criticism of the paint specification called for by the Railroad Administration and this phase of the question should be given attention, as it would be very poor practice to apply paint that is not suitable for the purpose and will not give satisfactory service. Paint the steel cars and do it before it is too late.

Bearing Pressures on Tender Truck Journals

The lubrication of locomotive tenders is recognized as a matter that requires constant attention at terminals. In spite of the fact that the journal boxes are inspected every trip and repacked if necessary, many roads find it advisable to run hose from the tank to each wheel as a precaution against delays due to hot boxes. Such conditions apparently indicate that the loads on tender journals are becoming excessive. Designers will no doubt protest that the weights carried are generally within the limits prescribed by the Master Car Builders' Rules for the association's standard sizes of journals. It is true that the limit weights have seldom been exceeded, but standards established for freight cars are not necessarily applicable to locomotive tenders. An analysis shows that some of the conditions met in tender service are favorable for good lubrication while others are unfavorable and in the end actual service results alone deserve to be considered. The weight of a tender when loaded can seldom be distributed equally between the front and rear trucks; furthermore, the surging of the water causes periods during which one side carries an undue share of the load. On the other hand, tenders are never fully loaded over the entire division.

Since the total weights of tenders for large locomotives often reach the limit of weight for four 6 in. by 11 in. journals, the next logical step to reduce the unit bearing pressure is the adoption of the six-wheel truck. It is interesting to note that one road which has used six-wheel tender trucks for several years has made this type standard for new power. While the adoption of six-wheel trucks is dictated by the necessity of overcoming the difficulties of lubrication, the change to the longer wheel base will probably show good results in a reduction of wear on wheel flanges and better riding qualities as well.

What About the Valve Setter?

There are probably few jobs within the whole range of locomotive repair work which, if they have the right kind of pride in good workmanship, the men performing them do not feel they are among the most highly essential to the best service of the locomotive. If the opinion of these men were to determine what jobs should carry with them a differential above the minimum established rate because of some special skill or care required for their proper performance, the result would be a much longer list than the comparatively few differentials fixed in the wage agreement between the Railroad Administration and the shop crafts, which went into effect October 20 last. As far as one set of rules can be made to meet the many sets of conditions as to shop practice and equipment which must be dealt with in the United States, the list of differentials established in this agreement may be considered fairly comprehensive. There is one notable exception, however, the high degree of skill for the proper performance of which is generally recognized. That is valve setting. The valve setter's work is reflected in the cost of operation of the locomotive for the entire period between shoppings. It is true that with the prevalence of outside valve gears on modern locomotives, the value of the skill of the old time valve setter may easily lost sight of. Even with these gears, however, a high degree of skill is required not only properly to maintain the correct steam distribution, but to get the work done without wasting a lot of time. Furthermore, the fact must not be lost sight of that there are still a large number of old locomotives with inside valve gears in service and as long as these engines run they burn coal, which is no less valuable because it may be consumed in branch line rather than in main line service. The valve setter's job is still one requiring a degree of skill and intelligence above the average and the only way to secure such a degree of skill and intelligence is to pay adequately for it.

Reinstating the Rules of Interchange

During the period of federal control the Rules of Interchange have been modified by circulars and by local agreements and some of the most important provisions have been suspended. When the railroads are turned back to their owners on January 1, it will be necessary to put the rules into effect once more in their entirety. Present conditions indicate that this will prove a serious task. Although some of the modifications of the rules have been recalled and defect carding has been reestablished, the regulations governing interchange are not being observed as they were prior to federal control. The men who were familiar with the workings of the rules prior to 1918 will not find it difficult to carry them out when they are once more put into force. Few changes have been made in the rules themselves during the period of federal control. For the most part the old rules have been retained and necessary modifications have been taken care of by supplementary circulars. Among the important changes appearing in the 1919 code of rules is the revision of Rule 32 to clarify fair and unfair usage and the addition of Rule 66 providing for the periodical repacking of journal boxes. Rule 88 has also been modified to facilitate repairing foreign cars and Rule 120 has been reinstated as issued in Circular 25.

With the small number of modifications of the rules and with experienced inspectors to form the basis of the new organization, it should not be difficult to put the rules in force once more if a concerted drive is made now to educate the new men. Railroad mechanical officers should consider that the period of federal control will soon be ended and should take immediate steps to insure that all car inspectors become conversant with the new rules in order that there may be no difficulty in putting them into effect on January 1. In order to assist our readers, the editors will welcome discussions of disputed points and will try to answer in the car department section any questions which are sent in regarding the application of the rules.

NEW BOOKS

Official Proceedings of the Eleventh Annual Convention of the Master Boiler Makers' Association.—192 pages, illustrated, 6 in. by 9 in. Bound in cloth. Published by the secretary, Harry D. Vought, 95 Liberty street, New York.

A complete report of the convention of the association, held at the Hotel Sherman, Chicago, Ill., May 26 to 29, 1919. Of especial interest are the committee reports and the discussion on "Threading Radial Stays and Tapping Holes for Same" and "The Best Method of Bracing Locomotive Tenders." The book is very well compiled and nicely bound and reflects credit on the association.

Storing. By H. B. Twyford. 200 pages, illustrated, 6 in. by 9 in., bound in cloth. Published by D. Van Nostrand Company, 25 Park Place, New York.

The necessity for storing stocks of materials of various kinds arises from the practical impossibility of obtaining a constant and uniform flow of materials from the raw state to the finished product at the point of consumption, and with the growing complexity of the modern industrial operations storage problems have also grown in complexity as well as in importance. In its broadest sense, the problem of modern storage not only involves questions of efficient methods of protecting and handling material, but many questions of a commercial nature must also be considered. In this volume the author has attempted to consider the whole range of questions involved in the storage problem, both economic and technical. The former are dealt with in a general way only, defining the fundamentals, and pointing out some of the more common mistakes of an economic nature. The technical problems are dealt with at greater length. Two chapters are devoted to the question of location, equipment and appliances for the storeroom, while the greater part of the work deals with storehouse operations, including discussions of clerical work, the storehouse organization and methods of accounting for and disposing of material received and delivered from the storeroom. Although, beyond the rather general discussion of the economic phases of storing, it has been the intention of the author to confine the discussion to the problems of the storekeeper rather than to include the related problems of purchasing, a brief discussion of the value of stores inventories is included. The book contains a large number of illustrations showing storehouse equipment and methods of handling material, as well as various forms required in properly listing and accounting for stores stock.

COMMUNICATIONS

INADEQUATE MAIN DRIVING BOXES

To the Editor: Allston, Mass.

In reply to Mr. Prescott's communication, appearing in your issue of September 1919, as to an error in quoting the taper of wedges, I would say that the locomotives under my observation have that taper and my statement in relation to the coefficient of friction holding them in position against the piston thrust along the zero line is practically acknowledged by his figures. That is to say, if the resulting moment of slip is 1 in. per ft., ¾ in. per ft. will be 25 per cent inside of the resulting moment.

As regards the spring thrust equipped wedges my observation of locomotives so equipped is, that where they do not hold the box as regards wedge adjustment, they do not cure the other troubles which cause the main driving box to pound.

The tendency of a wedge to unload may be demonstrated in practice in this manner: If, when on the road, a wedge should stick solid, the man running the locomotive will often get down and slack off the check nut supporting the wedge, leave the other two nuts below the wedge support locked together, and then drive the engine without any attempt to pull the wedge down, with the result that on arriving at the terminal point all that is necessary is to set the wedge up.

As an example of an opposite condition, we may assume a wedge forced up with a rigid wedge bolt, causing a tension strain from the wedge sticking, thus causing the bolt to part and the wedge to crawl up and stick. In this case the resistance offered to the wedge by the rigid wedge bolt below causes still further overload with a final result that oftentimes it is necessary to take down the pedestal brace and spring the jaws of the frame open to release the wedge.

These examples are intended to show that my line of thought is not in the direction of an equipment to do away with adjustment, but to argue for a more general application of an equipment to compensate for inequalities which, at times, it may be impossible for the persons concerned to conceive. If practice teaches us the wedge will unload, make provision for it when natural causes make it necessary.

My argument against the spring thrust is this: The physical law is that action and reaction are opposite and equal. In this case the wedges must unload against resistance, which means work set up against the force exerted to unload, and this brings us back to the horizontal along the zero line of the piston.

As to the boring out of the crown of the brass I have this to say: Twenty-eight years ago, as an apprentice, I observed the practice of filing out the crown of the brasses, after being perfectly fitted to the shaft, as the last operation before applying them to the shaft. At this time the oil groove was in the top of the crown and I have seen these boxes, after the locomotives were running, fitting the journal so tight that you could fill the oil hole with engine oil and not have the oil leak down around the sides of the journal.

Since that time, as locomotives increased in size to meet the needs of the transportation department, the oil groove has been moved down near to the zero line of the piston in the crown brasses, and the brasses are now scraped out in line with the piston thrust before they are run, in order to make them slightly larger than the journal and bear hard in the crown, which is directly opposite to the former practice.

In new locomotives coming direct from the builders the crown brasses are splined out one inch back into the crown in direct line with the piston thrust, which would indicate that the trouble was caused by the brasses gripping the journal across the zero line of the piston thrust.

This was the condition on locomotives equipped before the advent of the grease lubricated driving box and the trouble experienced when running at high speed was, perhaps, the cause of bringing about the grease equipped driving box.

At the same time that this trouble was experienced in running high speed locomotives equipped with oil I have seen both heavy Consolidation and switching locomotives shopped, with high mileage, on which the boxes would have to be scraped out in line with the piston thrust in order to get them back on the journal. These locomotives were shopped to turn the tires before the laws governing these things were in vogue and sometimes had ⅜-in. tread wear.

My purpose in speaking of these facts is to try to show that the generating of heat in high speed service is a factor which causes wear in line with the piston thrust.

I will state also that my observation of the way in which the wear takes place in heavy locomotives running at high speed, with high piston thrust, leads me to the conclusion that if a bearing was so designed as to completely surround the journal in direct line with the piston thrust that they will still continue to wear and pound if no provision is made in the design to compensate for the distance to the outside of the bearing beyond the neutral axis of the journal.

Friction is measured by the weight, the load being greatest at the point most distant from the neutral axis and no rigid parallel condition in line with the journal across the frames will meet the requirements of bringing sufficient surface into play to compensate for the tendency of the bearing to wear at the outside and next to the wheel hub.

I am in agreement with Mr. Prescott in regard to the importance of growing piston thrust and also as to the importance of getting into it at this time when the tendency in building is in the direction of simple engines and superheat, with greater mean effective pressure at high piston speed and increasing tractive effort. If we do not talk now and get the changes made, the locomotives will do the talking later on. John C. Murdock.

THERMIT vs. AUTOGENOUS WELDING

New Haven, Conn.

To the Editor:

In his letter in the July issue of the *Railway Mechanical Engineer* E. A. Murray quite pertinently sets forth the advantage of the Thermit process for a job such as he described. But apparently the damage was confined to distortion of members requiring straightening. The photograph and description do not disclose that there was any breaking up of the frame, as was the case with the frame welded at New Haven.* An inspection of the photograph shown on page 99 of the February, 1919, issue discloses the fact that both ends of the frame were practically destroyed. At each end, as far back as the transom member, the casting was broken up into many pieces, some so small as to be impossible to replace and for which it was necessary to substitute flanged steel plates, which were partly riveted and partly welded into place.

Three out of five of the sections making up the under portion of the underframe were distorted so that they had to be cut and straightened, and this portion of the operation of reclaiming presumably was practically the same as that in the case of the frame which Mr. Murray handled.

I have been familiar for a great many years with the merits of the Thermit process and know the fine work which can be done with it under some conditions. But the frame which we welded was so badly broken up that it would have been a physical impossibility to have repaired it with the Thermit process. I am taking the liberty of again bringing the matter up in order that the difference in the nature of the two jobs may be clearly drawn. W. L. Bean.

*See the February, 1919, issue of the *Railway Mechanical Engineer*, page 97.

Mikado Type Locomotive for Canadian Pacific Freight Service

New Canadian Pacific Locomotives

Mikado Type for Freight Service; Heavy Frame Construction and Interchangeable Side Rods

BY W. A. NEWMAN
Engineer of Locomotive Construction

The locomotive building program now being carried out by the Canadian Pacific Railway includes four new types of locomotives; a Mikado type locomotive having a tractive effort of 56,000 lb., two classes of Pacific type locomotives with 43,700 and 42,600 lb. tractive effort respectively, and a Santa Fe type locomotive with a tractive effort of 66,000 lb. All of these locomotives have been designed by the mechanical engineering department of the Canadian Pacific and are being contsructed at the Augus shops in Montreal.

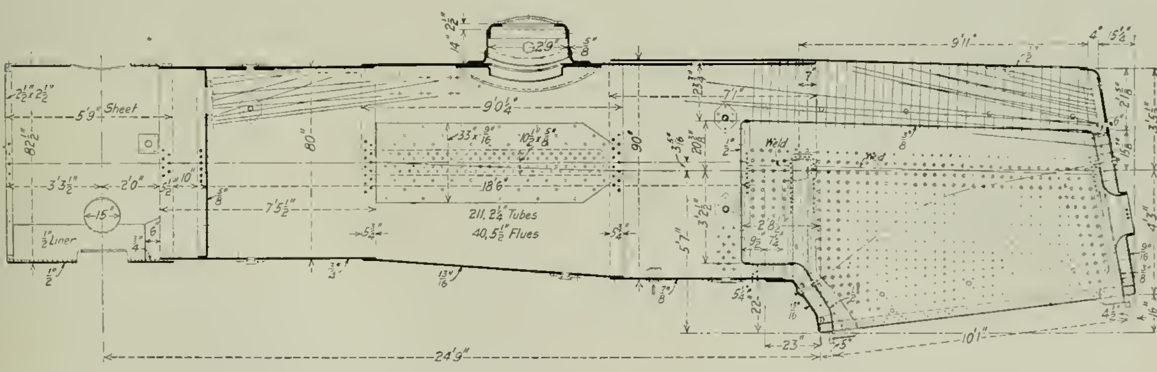
The initial order of 10 Mikado type locomotives has already been completed and one of them is described in this article. The other new types of locomotives are now building and will be described in later issues of this publication.

The design of the Mikado locomotives is largely based on the experience obtained from the earlier Mikado type which was designed and constructed by the Canadian Pacific in 1912. There are no radical departures from what is commonly accepted as standard practice. Close attention has, however, been paid to the design of every detail and no effort spared to produce a common-sense locomotive which will give reliable and efficient service.

The locomotives have a total weight of 320,500 lb., with 235,000 lb. on the driving wheels, which gives a factor of adhesion of 4.18. The cylinders are 25 in. by 32 in., driving wheels 63 in. outside diameter, which with a normal boiler pressure of 200 lb. per sq. in., gives a maximum calculated tractive effort of 56,000 lb.

THE BOILER

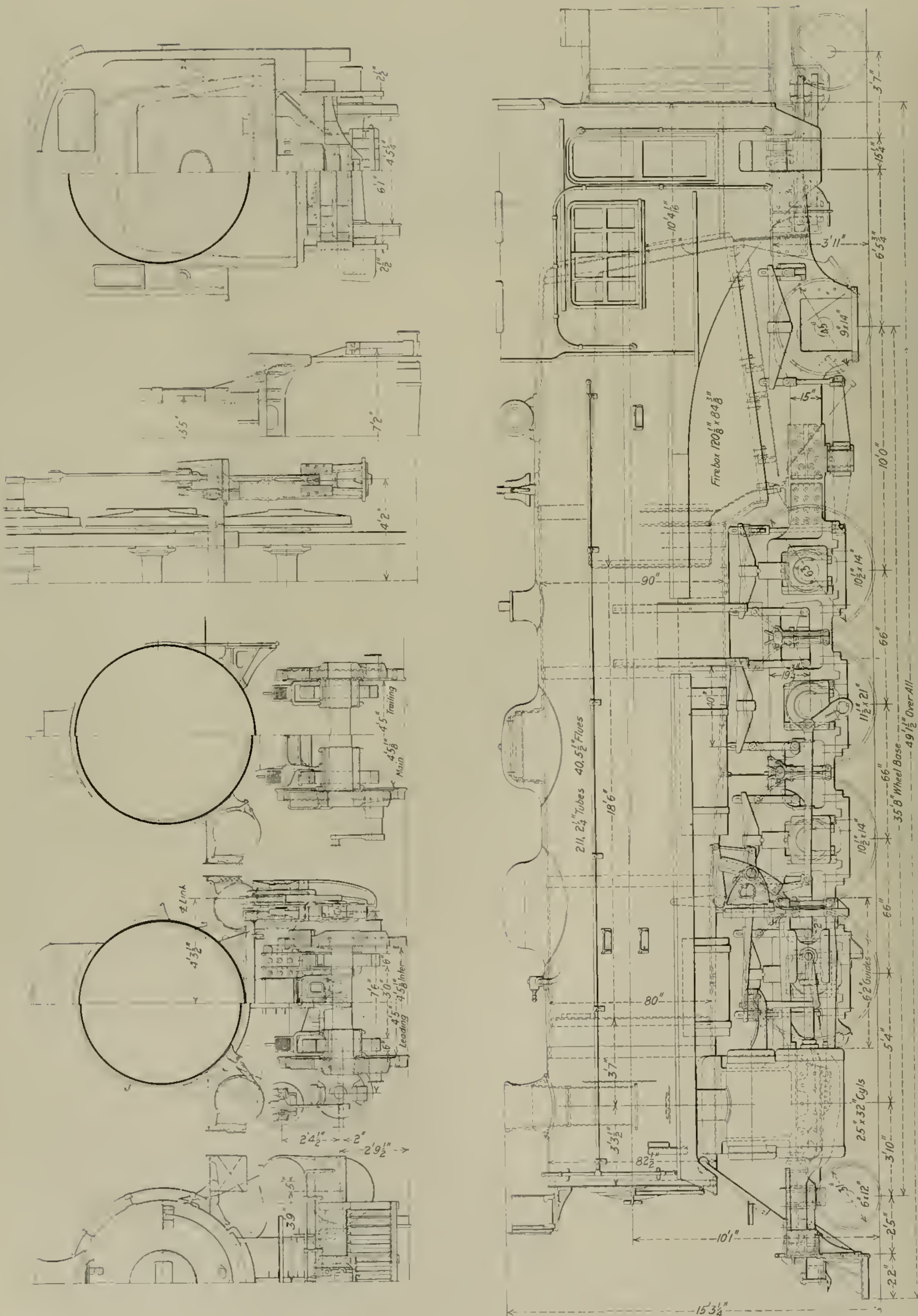
The boilers are of the extension wagon bottom type, and are the first of this kind to be used on Canadian Pacific locomotives. This type of construction was adopted for several reasons: the steam dome can be located on the second course, which simplifies the seam construction on the third course; the standpipe is further away from the crown sheet where the greatest ebullition occurs; it shortens the dry pipe and consequently the length of the steam passage, and provides a greater steam storage space, which should be of material advantage in increasing superheater efficiency.



Extension Wagon Bottom Boiler for Canadian Pacific Mikado Type Locomotive

The boiler design is the result of a very careful study of boiler proportions and construction, every care being taken to insure ample steam generating capacity, combined with easy steaming qualities. The smallest details of construction were given close attention with ease of maintenance in view.

The capacity of the boiler in relation to the cylinder requirements is 102.5 per cent, based on Cole's ratios. The



Elevation and Cross Sections of Mikado 2-8-2 Locomotive and Arrangement of Ragonnet Reverse Gear length of tubes is 18 ft. 6 in., which is a close approximation of the most efficient ratio of tube length to diameter. A 28-in. barrel combustion chamber is used, this being the first combustion chamber of this type on the Canadian Pacific Railway. The mudring ends are of cast steel welded to wrought iron side pieces. The ends have drop corners to allow through riveting for the corner fastening of the inside firebox sheet.

THE FRAMES

The frames are a little heavier than is usually found in general locomotive practice. This is chiefly on account of the difficulty experienced with frame breakages, particularly in sections of Canada in which extremely low winter temperatures are experienced. The frames are of the single front rail type and it has been the experience of the Canadian Pacific that the majority of breakages with such frames come directly behind the cylinders. This apparently has been largely due to insufficient fastening to the cylinders and on account of the twisting strains set up due to the narrow bolting face of the cylinders in comparison with the total depth of the frame through the pedestals. In an attempt to correct this, a 15-in. depth of frame section at the back of the cylinders has been used and an extension lug carried forward from the top rail of the frame, which engages with and bolts to a vertical lug on the back wall of the cylinder casting. This gives a total vertical bolting face at the back of the cylinders of 29½ in., which it is expected will effectively counteract any twisting strain to which this section of the frame will be subjected. This construction is shown in detail in the illustrations.

Special Wedge Casting to Reinforce the Frame and Cylinder Casting

In addition to being bolted to the usual side vertical bolting face underneath the cylinders, each frame is further secured by being bolted through a casting which extends between the locomotive frames and bears against extension lugs at the center of the cylinder castings. These lugs have a tapered face, and the whole casting is first driven in place, secured by vertical bolts, and then bolted horizontally through the frame and cylinders.

The frames are of a uniform width of 6 in. throughout. The depth of section at the top of the pedestal is 6¾ in., the minimum depth of the top rail between pedestals 5¾ in., and the minimum depth at the bottom rail 4½ in.

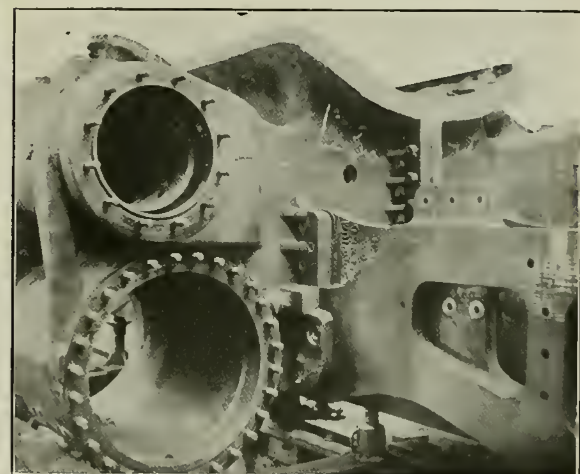
TRAILING TRUCK

The locomotives are equipped with the Vaughan trailing truck, the extension frame being outside the trailing wheels and spaced 6 ft. 3½ in. center to center. No radius bar is used with these trucks, the guiding motion being obtained from inclined vertical faces on the journal boxes which bear against faces having the same incline, on the pedestals attached to the extension frame. This type of truck has been used on Canadian Pacific locomotives for the past 13 years and has given satisfactory service.

ASH PAN AND GRATES

The chief advantages of this construction of rear frame are simplicity and that an ash pan of ample capacity can be obtained with very few relatively flat horizontal surfaces, as will be seen by a study of the ash pan drawing. An ash pan of ample capacity and with quick slopes is absolutely imperative for locomotives operating in cold climates, and a great deal of attention was given to the design of this ash pan. As far as possible, all corner angles are located outside the pan and straight joints in the plate formed by flanging the plate to the outside, the joint being made with sheet asbestos. This construction removes a great many bolt heads from the inside of the pan. The ash pan doors are of the swinging type and are supported from pivot points located back of the door center of gravity, so that the doors are self-closing by their own weight. This is particularly advantageous from a standpoint of fire risk. The ash pan is supported by a combination cast steel bracket, which also forms a support for the grate side carriers.

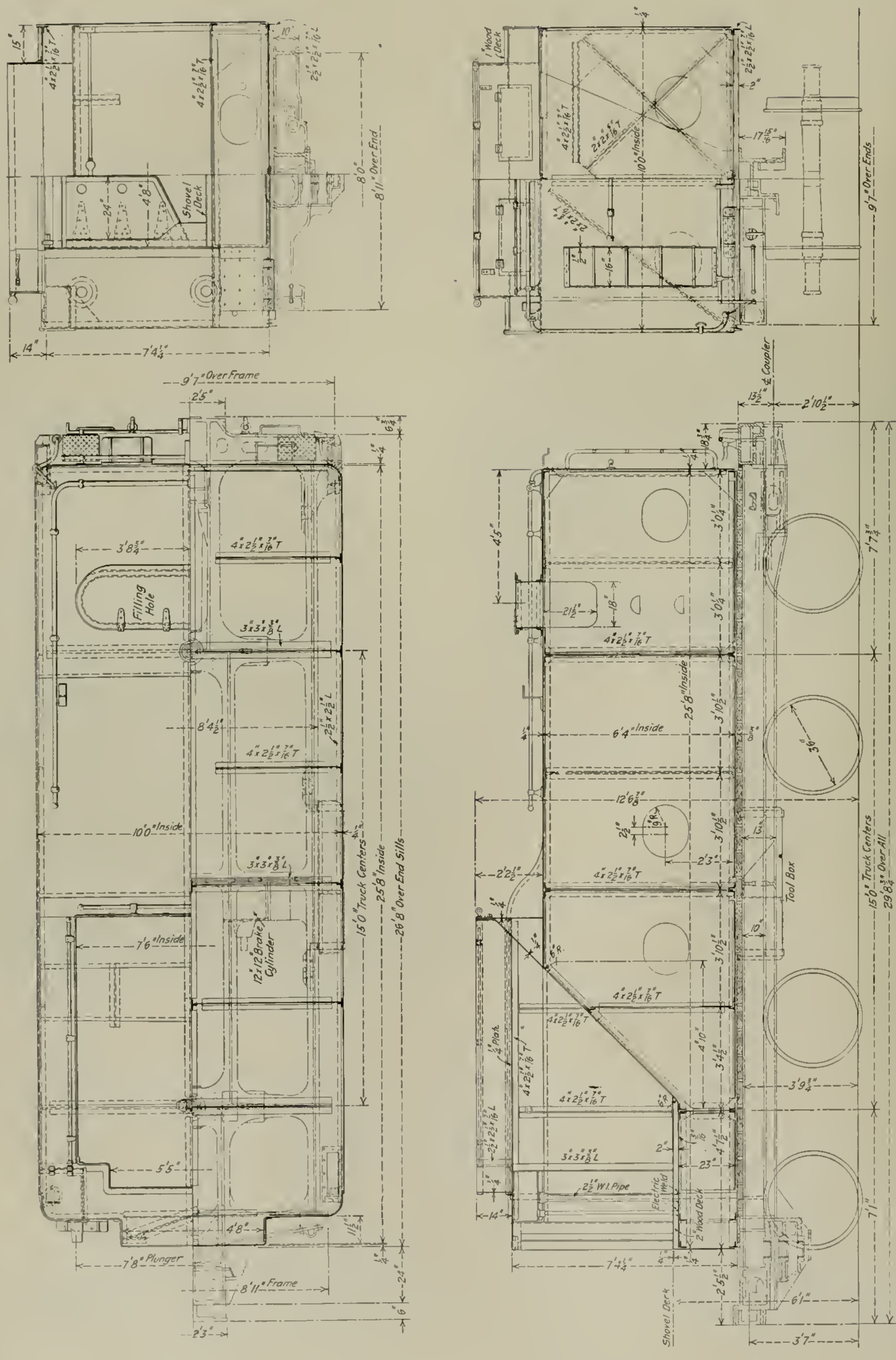
The grates are of the butt finger type, 10 in. wide, are in four sections, and are all moving grates. Dead grates at the front and back have been eliminated. The center carrier is of very light cast steel construction and is reinforced along the bottom or tension member by a structural tee iron, shrunk in place and riveted. Careful attention was given to the design of the grate side carriers to eliminate warping. The design finally adopted has the side carriers in two sections. This permits a stiffer construction and also facilitates any repairs to firebox corners, as only one section of the grates need be removed.



Extension Lug on the Frame Bolted to Vertical Lug on the Cylinder Casting

RODS AND MOTION WORK

The main and side rods are of ordinary carbon steel and present no unusual features, except that the front and back side rods have been made interchangeable; that is, the back right and front left side rods are identical. The piston heads are of cast iron and are considerably lighter than heads two inches smaller in diameter which have been used as standard on other Canadian Pacific locomotives. This is



Two-Piece Water Bottom, 8000 Imperial Gal. Capacity Tender with 45 Deg. Coal Sheet and Special Swash Plate Bracing the result of a very close analysis, both mathematically and by actual tests, of the stresses in piston heads. The crosshead is a modification of that previously used as standard by the Canadian Pacific. The body of the crosshead is cast in one piece and takes removable cast iron wearing pads, which are in three sections, top and bottom, and are retained in place by side plates which are bolted to the crosshead body.

The union link connection to the crosshead is slightly unusual. It is apparently carried by the wrist pin, but actually works on a bearing which is part of the inside washer. This washer fits on a tapered shoulder on the crosshead body, so that the wrist pin is relieved of any thrust from the union link.

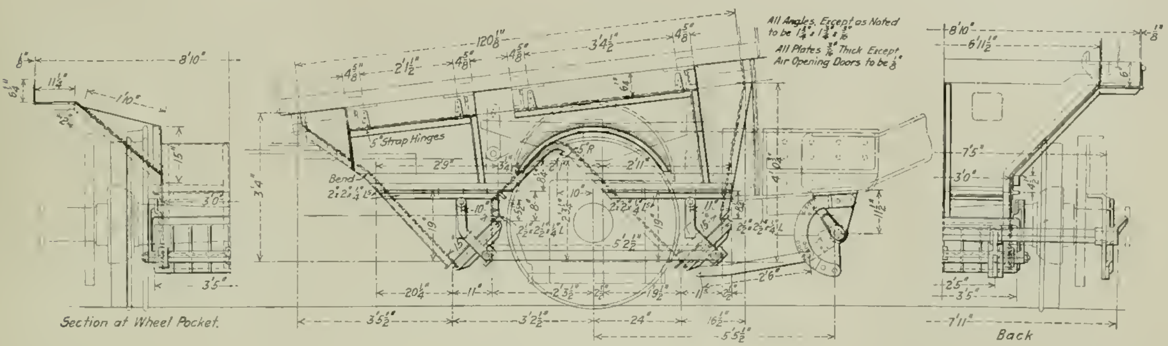
Although all motion parts are of ordinary carbon steel, particular attention has been given in their design, to the reduction of weight, with the result that the reciprocating parts are only 96 lb. heavier than those used on the lighter Mikado type engine, which is an increase in weight of 5.87 per cent, as against an increase in piston load of 31 per cent.

SAND BOX AND CAB FITTINGS

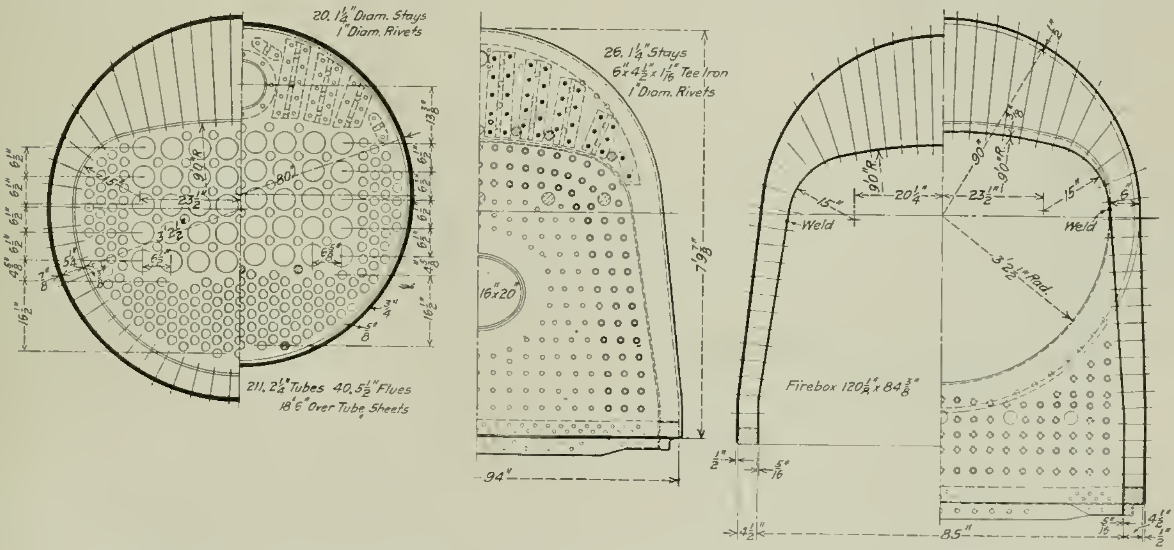
An oval sand box is used which has a capacity of 20 cu. ft. This is of built-up construction, the bottom being flanged in two parts and joined at the center by a riveted butt joint. The top is flanged in one piece. This gives an extremely light construction for the large carrying capacity, the total weight of the sand box empty being 975 lb.

Every effort was made to obtain the most efficient layout on the back head of the boiler so that all valves, the throttle lever, lubricator, air brake equipment, etc., would all be properly located, and at the same time permit both the engineman and fireman to have an unobstructed view of the water glass and steam gage.

The width of the firebox prevented locating the brakeman's seat in the usual position ahead of the fireman's seat and between the firebox and the cab side. The cab is of the Canadian Pacific standard vestibule type, and it was finally decided to locate the brakeman's seat directly behind the fireman's. The vestibule cab includes two lockers, one on either side of the cab, back of the doors. To make room for the brakeman's seat, the locker on the left hand side was omitted and the height of the locker on the right side increased to six feet. A fold-up brakeman's seat was then located on the left side in such a way that with the seat dropped in place and the door closed, a drop panel in the door forms a window to enable the brakeman to look out. This window is provided with a small arm rest of the usual construction, which folds inward when the door panel



Arrangement of Ashpan for Canadian Pacific Mikado Locomotive



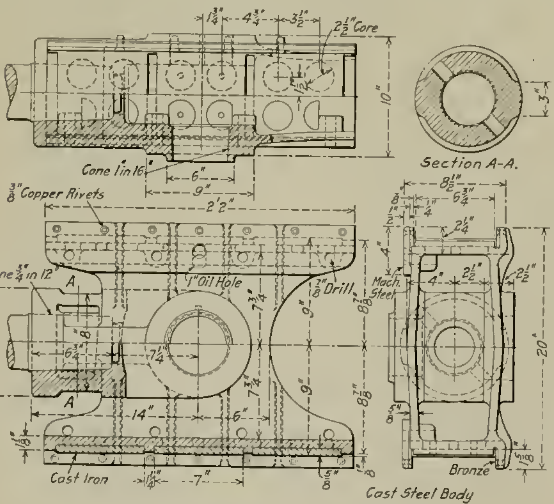
Half Views of Front Firebox Sheet, Front Tube Sheet and Back Head and Section Through Firebox at Throat is raised. The locker on the right side of the cab is divided into two parts, the 4-ft. upper locker being lined with wood and furnished with coat hangers to take the crew's clothes. The bottom locker is used for supplies, and the signal equipment is carried in a wire rack located under the roof of the cab.

THE TENDER

The tender is of the water bottom construction with a total capacity of 8,000 Imperial gallons, which is equivalent to 9,600 American gallons, and has a coal capacity of 12 tons. The slope of the back coal sheet is 45 deg., which is sufficient to insure that all the coal is fed to the front of the coal space, and dispenses with the use of a coal pusher. This is Canadian Pacific standard construction, all locomotive tenders being fitted in this way. The tank bottom is in two pieces, having one longitudinal butt joint with inside and outside welts. The swash plate bracing has been very carefully worked out in order to eliminate all unnecessary strains on the riveting and to insure freedom from trouble from leaky tenders. The tank is supported by a Commonwealth one-piece cast steel underframe. The tender trucks are of the equalizer type with combination semi-elliptic and coil springs.

SPECIAL EQUIPMENT AND AIR BRAKE

These locomotives are equipped with Security brick arches, Cole extension main driving boxes, Franklin automatic driving box wedges, Franklin radial buffers, Franklin unit safety bar (of standard C. P. R. laminated design), Franklin vertical type steam grate shakers, Franklin No. 8 automatic firedoors, Economy engine truck, Nathan type "T" top checks, World safety valves, Detroit lubricators, Hancock non-lifting type "H. N. L." inspirators on the left



Crosshead With Cast Iron Wearing Pads

side, and Hancock type "A" lifting inspirators on the right side, Ragonnet reverse gear, Never-Clog air-sanders and Pyle-National turbo generators with incandescent headlights.

The air brake is the Westinghouse schedule "ET" with cross-compound air compressors. Ample cooling surface is provided in the air brake piping, 2-in. pipes being used between the compressor and the first reservoir. A parasite reservoir is also part of the air system with which this locomotive is equipped, and the pressure is controlled by a Westinghouse Parasite governor.

The locomotives are hand-fired and have proved exceptionally easy steamers, and quite live up to the expectations of economy in coal and water.

The principal data and dimensions are as follows:

General Data

Gage	4 ft. 8½ in
Service	Freight
Fuel	Bit coal
Tractive effort	56,147 lb.
Weight in working order	320,500 lb.
Weight on drivers	235,000 lb.
Weight on leading truck	28,000 lb.
Weight on trailing truck	57,500 lb.
Weight of engine and tender in working order	498,600 ib.
Wheel base, driving	16 ft. 6 in.
Wheel base, total	38 ft. 8 in.
Wheel base, engine and tender	68 ft.

Ratios

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. Coal
Tractive effort	56,147 lb.
Weight in working order	320,500 lb.
Weight on drivers	235,000 lb.
Weight on leading truck	28,000 lb.
Weight on trailing truck	57,500 lb.
Weight of engine and tender in working order	498,600 lb.
Wheel base, driving	16 ft. 6 in.
Wheel base, total	35 ft. 8 in.
Wheel base, engine and tender	68 ft.
Weight on drivers ÷ tractive effort	4.18
Total weight ÷ tractive effort	5.7
Tractive effort × diam. drivers ÷ equivalent heating surface*	717
Equivalent heating surface* ÷ grate area	70.1
Firebox heating surface ÷ equivalent heating surface,* per cent	9.47
Total weight ÷ equivalent heating surface*	65.0
Volume both cylinders	18.9 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	261.0
Grate area ÷ vol cylinders	3.72

Cylinders

Kind	Simple
Diameter and stroke	25 in. by 32 in.

Valves

Kind	Piston
Diameter	14 in.
Greatest travel	6½ in.
Outside lap	1⅛ in.
Inside clearance	⅛ in.
Lead in full gear	3/16 in.

Wheels

Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11½ in. by 21 in.
Driving journals, others, diameter and length	10½ in by 14 in.
Engine truck wheels, diameter	31 in.
Engine truck, journals	6 in. by 12 in.
Trailing truck wheels, diameter	45 in.
Trailing truck, journals	9 in. by 14 in.

Boiler

Style	Extended wagon bottom
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	80 in.
Firebox, length and width	120⅛ by 84⅜ in.
Firebox plates, thickness	Tube ½in., crown and back ⅜ in, sides 5/16 in.
Firebox, water space	Front 5 in., back and sides 4½ in.
Tubes, number and outside diameter	211, 2¼ in.
Flues, number and outside diameter	40, 5½ in.
Tubes and flues, length	18 ft. 6 in.
Heating surface, tubes and flues	3,347. 78 sq. ft.
Heating surface, firebox, including arch tubes	317 sq. ft.
Heating surface, total	3,664.78 sq. ft.
Superheater heating surface	845 sq. ft.
Equivalent heating surface*	4,932.28 sq. ft.
Grate area	70.3 sq. ft.

Tender

Tank	Water bottom
Frame	Cast steel
Weight	178,100 lb.
Wheels, diameter	36 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	8,000 imp. gal.
Coal capacity	12 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

Brazilian Coal.—According to the British Chamber of Commerce in Brazil, it is reported that experiments have recently been made by the Central Railway with briquettes composed of national coal from the Caçapava mines and American fuel. The experiments, which were carried out under strict technical requirements, gave excellent results and fully satisfied the experts who were present. It is believed, says the Chamber of Commerce, that the tests made with the Caçapava coal, from mines in the state of Sao Paulo, situated close to the Central Railway, with which it will shortly be linked up by a branch line of 12 km., may eventually lead to a decrease of over 50 per cent in the imports of American coal making an appreciable economy.

Shop Employees' Wage Agreement

Negotiated with Railroad Administration; Includes the Wage Adjustments and Working Conditions

Director General Hines entered into the following agreement, effective October 20, with the shop employees on roads under federal operation, represented by the Railway Employees' Department of the American Federation of Labor and it affiliated organizations of the Mechanical Section and Divisions Nos. 1, 2 and 3, thereof, including the International Association of Machinists, International Brotherhood of Boilermakers, Iron Ship Builders and Helpers of America, International Brotherhood of Blacksmiths and Helpers, Amalgamated Sheet Metal Workers' International Alliance, International Brotherhood of Electrical Workers, and the Brotherhood Railway Carmen of America.

It is understood that this agrement shall apply to those who perform the work specified in this agreement in the maintenance of equipment, maintenance of way, signal maintenance (except electricians engaged in signal maintenance, telegraph maintenance and all other departments of all railroads in federal operation, shop employees of American Railway Express, and Pullman Car Line employees having the same working conditions as specified in Supplement No. 4 to General Order No. 27. It is understood that this agreement does not annul agreements already in effect with other organizations unless and until a majority of the employees concerned express a desire for a change.

GENERAL RULES

Hours of Service.—Rule 1. Eight hours shall constitute a day's work. All employees coming under the provisions of this schedule, except as provided for in Rule 15, shall be paid on the hourly basis.

Rule 2. When one shift is employed, the starting time shall be not earlier than 7 o'clock, and not later than 8 o'clock. The time and length of the lunch period shall be subject to mutual agreement.

Rule 3. Where two shifts are employed, the starting time of the first shift shall be governed by Rule 2, and the second shift shall start immediately following the first shift, or at 8 p. m. The spread of the second shift shall consist of eight consecutive hours, including an allowance of 20 minutes for lunch within the limits of the fifth hour.

Rule 4. Where three shifts are employed, the starting time of the first shift shall be governed by Rule 2, and the starting time for each following shift shall be regulated accordingly. The spread of each shift shall consist of eight consecutive hours, including an allowance of 20 minutes for lunch within the limits of the fifth hour.

Rule 5. The time established for commencing and quitting work for all men on each shift shall be the same at the respective points, but where three shifts are worked by running repair forces, and two shifts by back shop forces, the quitting time of the first shift and the commencing and quitting time of the second shift of the back shop forces will be governed by the provisions of Rule 3.

Exception.—It is agreed that three eight hour shifts may be established under the provisions of Rule 4, for the employees necessary to the continuous operation of power houses, millwright gangs, heat treating plants, train yard running repair and inspection forces (not repair tracks) without extending the provisions of Rule 4 to the balance of the shop forces.

Rule 6. All overtime, except as the provisions of Rules 7, 9, 10 and 15 apply, outside of bulletin hours, up to and including the sixteenth hour of service in any one 24-hour period, computed from the starting time of the employee's regular shift, shall be paid for at the rate of time and one-half and thereafter at the rate of double time, up to the starting time of the employee's regular shift. This to include work performed on Sundays, New Year's Day, Washington's Birthday, Decoration Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas and such state holidays as are now recognized as punitive overtime days at the various points on the respective railroads within the different states.

Rule 7. For continuous service after regular working hours, employees will be paid one hour for forty minutes' service or less, and shall not be required to work more than one hour without being permitted to go to meals. Employees called or required to return to work will be allowed five hours for three hours and twenty minutes' service or less. They shall be required to do only such work as held or called for.

Rule 8. Employees regularly assigned to work on Sundays or holidays, or those called to take the place of such employees, will be allowed to complete the balance of the day unless released at their own request. Those who are called will be advised as soon as possible after vacancies become known.

Rule 9. Employees required to work during lunch period shall receive pay for one hour straight time and be allowed necessary time to procure lunch without loss of time. This does not apply where employees are allowed the twenty minutes for lunch without deduction therefor.

Rule 10. Employees, except as the provisions of Rules 12 and 15 apply, sent out on the road for emergency service, shall receive continuous time from the time called until their return as follows:

Overtime Emergency Service Road Work.—Overtime rates for all overtime hours and straight time for the recognized straight time hours at home station, whether working, waiting or traveling, except that after the first 24 hours, if relieved from duty and permitted to go to bed for five or more hours, they will not be allowed time for such hours, provided that in no case shall an employee be paid for less than eight hours on week days, and eight hours at one and one-half time for Sundays and recognized holidays, for each calendar day. Where meals and lodging are not provided by the railroad, actual expenses will be allowed. Employees will receive all allowances for expenses not later than the time when they are paid for the service rendered. Employees will be called as nearly as possible, one hour before leaving time, and on their return will deliver tools at point designated

Rule 11. When it becomes necessary for employees to work overtime, they shall not be laid off during regular working hours to equalize the time. At points where sufficient number of employees are employed, employees shall not work two consecutive Sundays (holidays to be considered as Sundays). Record will be kept of overtime worked and men called with the purpose in view of distributing the overtime equally.

Rule 12. When necessary to fill temporary vacancies at outlying points, employees, excluding those specified in Rules 14 and 15, will be sent out and will be paid for this service as follows: Continuous time for time called up to time of reporting at point to which sent, overtime rates for all overtime hours, and straight time for the recognized straight time hours at home station, whether waiting or traveling (the same provisions to apply for return trip). While at such point they will be paid straight time and overtime in accordance with practice at home point with a guarantee of not less than eight hours' pay, at the established rate, for each calendar day, including Sundays and holidays at overtime rates. Where meals and lodging are not provided by the railroad, actual expenses will be allowed. Rules in existing agreements or shop rules covering the road service described in Rules 10 and 12, which are more favorable to the employees, are to be preserved.

Rule 13. Employees changed from one shift to another will be paid overtime rates for the first shift of each change. Employees working two shifts or more on a new shift shall be considered transferred.

Rule 14. Employees regularly assigned to road work whose tour of duty is regular, and who leave and return to home station daily (a boarding car to be considered a home station) shall be paid continuous time from the time of leaving the home station to the time they return, whether working, waiting or traveling, exclusive of the meal period, at straight time for the regular hours, and overtime rates for all overtime hours, as per overtime rules. The starting time to be not earlier than 6 a. m., nor later than 8 a. m. Where two or more shifts are worked, the starting time of each following shift will be regulated accordingly.

Rule 15. Employees regularly assigned to perform road work and paid on a monthly basis, shall be paid not less than the minimum hourly rate established for the corresponding class or employees coming under the provisions of this schedule, on the basis of 365 eight-hour days per calendar year, with pay at the rate of time and one-half time for Sundays and holidays designated herein; otherwise, overtime will not be paid. Where meals and lodging are not furnished by the railroad, or when the service requirements make the purchase of meals and lodging necessary, while away from home point, employees will be paid actual expenses. This service is distinct and separate from that performed by any other class of employees coming under the provisions of this schedule and is not to be confused therewith; the employees assigned to it shall not be assigned to or used to perform the construction, repair and emergency work assigned to the other employees under the provisions of the general and special rules of this schedule.

NOTE

The following is an example to be followed in arriving at the monthly rate:

365 days multiplied by 8 equals	2,920 hours
59 Sundays and holidays at one-half time will be 59 x 4, equaling	236 hours
Total hours to be paid for	3,156 hours

The monthly salary is arrived at by dividing the total earnings of 3,156 hours by 12; no overtime is allowed for time worked in excess of eight hours per day; on the other hand, no time is to be deducted unless the employee lays off of his own accord.

Filling Vacancies.—Rule 16. When an employee is required to fill the place of another employee receiving a higher rate of pay, he shall receive the higher rate, but if required to fill, temporarily the place of another employee receiving a lower rate, his rate will not be changed.

Rule 17. Employees serving on night shifts, desiring day work, shall have preference when vacancies occur, according to their seniority.

Rule 18. When new jobs are created or vacancies occur in the respective crafts, the oldest employees in point of service shall, if sufficient ability is shown by trial, be given preference in filling such new jobs or any vacancies that may be desirable to them. All vacancies or new jobs created will be bulletined. Bulletins must be posted five days before vacancies are filled permanently. Employees desiring to avail themselves of this rule will make application to the official in charge and a copy of the application will be given to the local chairman.

Rule 19. Mechanics in service will be considered for promotion to positions as foremen. When vacancies occur in positions of gang foremen men from the respective crafts will have preference in promotion.

Rule 20. Employees transferred from one point to another, with a view of accepting a permanent transfer, will, after 30 days, lose their seniority at the point they left and their seniority at the point to which transferred will begin on date of transfer, seniority to govern. Employees will not be compelled to accept a permanent transfer to another point.

Rule 21. When the requirements of the service will permit, employees, on request, will be granted leave of absence for a limited time, with privilege of renewal. An employee absent on leave who engages in other employment, will lose his seniority unless special provisions shall have been made therefor by the proper official and committee representing his craft. The arbitrary refusal of a reasonable amount of leave of employees when they can be spared, or failure to handle promptly cases involving sickness or business matters of serious importance to the employee, is an improper practice and may be handled as unjust treatment under this agreement.

Absence from Work.—Rule 22. In case an employee is unavoidably kept from work he will not be discriminated against. An employee detained from work on account of sickness or for any other good cause shall notify his foreman as early as possible.

Faithful Service.—Rule 23. Employees who have given long and faithful service in the employ of the company and who have become unable to handle heavy work to advantage, will be given preference of such light work in their line as they are able to handle.

Attending Court.—Rule 24. When attending court as witnesses for the railroad, employees will receive pay for all time lost at home station, with a minimum of eight hours' time each week day and eight hours at rate and one-half for Sundays and holidays, either at home station, away from home, or traveling. Time and one-half will be paid for traveling during overtime hours where emplyoees are unable to secure sleeping car accommodation. Actual expenses will be allowed when away from home station, and necssary expenses will be allowed when at home. When necessary, the company will furnish transportation and will be entitled to certificate for witness fees in all cases.

Paying Off.—Rule 25. Employees will be paid off during their regular working hours, semi-monthly, except where existing state laws provide a more desirable paying off condition. Should the regular pay day fall on a holiday or days when the shops are closed down, men will be paid on the preceding day. Where there is a shortage equal to one day's pay or more in the pay of an employee, a voucher will be issued to cover the shortage. Employees leaving the service of the company will be furnished with a time voucher covering all time due within 24 hours where D. C. checks are issued and within 48 hours at other points, or earlier when possible.

Rule 26. During inclement weather provision will be made where buildings are available to pay employees under shelter.

Reduction of Forces.—Rule 27. When it becomes necessary to reduce expenses, the force at any point or in any department or sub-division thereof shall be reduced, seniority as per Rule 31 to govern; the men affected to take the rate of the job to which they are assigned. Five days' notice will be given men affected before reduction is made, and lists will be furnished local committee. In the restoration of forces, senior laid off men will be given preference of re-employment, if available, within a reasonable time, and shall be returned to their former position; local committee will be furnished list of men to be restored to service; in reducing force the ratio of apprentices will be maintained.

Rule 28. Employees laid off on account of reduction in force, who desire to seek employment elsewhere, will, upon application, be furnished with a pass to any point desired on the same railroad.

Rule 29. When reducing forces, if men are needed at any other point they will be given preference to transfer to nearest point, with privilege of returning to home station when force is increased, such transfer to be made without expense to the company. Seniority to govern all cases.

Rule 30. Employees required to work when shops are closed down, due to breakdown in machinery, floods, fires, and the like, will receive straight time for regular hours, and overtime for overtime hours.

Seniority.—Rule 31. Seniority of employees in each craft covered by this agreement shall be confined to the point employed in each of the following departments: Maintenance of Way (Bridge and Building where separate from Maintenance of Way Department); Maintenance of Equipment; Maintenance of Telegraph; Maintenance of Signals; four subdivisions of the Carmen as follows: Patternmakers, Upholsters, Painters, and other Carmen. The seniority lists will be open to inspection and copy furnished the committee.

Assignment of Work.—Rule 32. None but mechanics or apprentices regularly employed as such shall do mechanics' work as per special rules of each craft, except foreman at points where no mechanics are employed.

Rule 33. In compliance with the special rules included in this agreement, none but mechanics and their apprentices in their respective crafts shall operate oxy-acetylene, thermit, or electric welders; where oxy-acetylene or other welding processes are used, each craft shall perform the work which was generally recognized as work belonging to that craft prior to the introduction of such processes, except the use of the cutting torch when engaged in wrecking service.

Filling Foremanship Temporarily.—Rule 34. Should an employee be assigned temporarily to fill the place of a foreman, he will be paid his own rate, straight time for straight time hours and overtime for overtime hours, if greater than the foreman's rate. If it is not, he will get the foreman's rate. Such positions shall be filled only by mechanics of the respective craft in their departments.

Grievances.—Rule 35. Should any employee subject to this agreement believe he has been unjustly dealt with, or any of the provisions of this agreement have been violated, the case shall be taken to the foreman, general foreman, master mechanic, or shop superintendent, each in their respective order, by the duly authorized local committee or their representative. If stenographic report of investigation is taken, the committee shall be furnished a copy. If the result still be unsatisfactory, the duly authorized general committee, or their representatives, shall have the right of appeal, preferably in writing, to the higher officials designated to handle such matters in their respective order, and conference will be granted within ten days of application. All conferences between local officials and local committees to be held during regular working hours without loss of time to committeemen.

Rule 36. Should the highest designated railroad official or his duly authorized representative and the duly authorized representative of the employees fail to agree, the case shall then be jointly submitted in writing to the chief executive officer of the railroad and the chief executive officer of the Railway Employees' Department of the American Federation of Labor for adjudication or final disposition. The methods of procedure will be those prescribed by the Railroad Administration. To the extent that these rules may remain in force after the expiration of federal operation, the methods of procedure will thereafter be such as may be agreed to by the representatives of the railroads and the representatives of the organizations herein specified. Prior to the assertion of grievances as herein provided, and while questions of grievances are pending, there will neither be a shut down by the employer nor a suspension of work by the employees.

Rule 37. An employee who has been in the service of the railroad 30 days shall not be dismissed for incompetency, neither shall an employee be discharged for any cause without first being given an investigation.

Rule 38. If it is found that an employee has been unjustly discharged or dealt with, such employee shall be reinstated with full pay for all time lost.

Committees.—Rule 39. The company will not discriminate against any committeemen, who from time to time, represent other employees, and will grant them leave of absence and free transportation when delegated to represent other employees.

Apprentices.—Rule 40. All appretices must be able to speak, read, and write the English language and understand at least the first four rules of arithmetic. Applicants for regular apprenticeship shall be between 16 and 21 years of age, and if accepted, shall serve four years of 290 days each calendar year. If retained in the service at the expiration of their apprenticeship they shall be paid not less than the minimum rate established for journeymen mechanics of their respective crafts. In selecting helper apprentices, seniority will govern and all selections will be made in conjunction with the respective craft shop committees. (Note: See special rules of each craft for additional apprentice rules.)

Rule 41. All apprentices must be indentured and shall be furnished with a duplicate of indenture by the company, who will also furnish every opportunity possible for the apprentice to secure a complete knowledge of the trade.

No apprentice will be started at points where there are not adequate facilities for learning the trade.

Rule 40 shall govern in the employment of apprentices.

FORM OF INDENTURE

This will certify that............................... ...was employed as a ....apprentice by the.............................Railroad, at...........................on.......... ....19..., to serve four years, a minimum of two hundred and ninety days each.

....
(Title of officer in charge.)

SERVICE PERFORMED DURING APPRENTICESHIP

....
....
....

This will certify that on................, 19.... .... completed the course of apprenticeship specified above and is entitled, if employed by the..........................Railroad to the rates of pay and conditions of service of...

....
(Title of officer in charge.)

Note: *The above form is to be used both for regular and helper apprentices. (Helper apprentices to serve 3 years.)*

Rule 42. The ratio of apprentices in their respective crafts, shall not be more than one to every five mechanics. Two apprentices will not be worked together as partners. The distribution of apprentices among shops where general repairs are made on the division shall be as nearly as possible in proportion to the mechanics in the respective trades employed therein. In computing the number of apprentices that may be employed in a trade on a division, the total number of mechanics of that trade employed on the division will be considered. If, within six months, an apprentice shows no aptitude to learn the trade, he will not be retained as an apprentice. An apprentice shall not be dismissed or leave the service of his own accord, except for just and sufficient cause, before completing his apprenticeship. Apprentices shall not be assigned to work on night shifts. An apprentice shall not be allowed to work overtime during the first three years of his apprenticeship. If an apprentice is retained in the service upon completing the apprenticeship, his seniority rights as a mechanic will date from the time of completion of apprenticeship. Preference will be given to sons of employees in the selection of apprentices to the extent of at least 80 per cent of the number employed.

Rates of Pay.—Rule 43. The rate for all mechanics who were receiving 68 cents per hour or more under Supplement 4 to General Order 27, except those provided for in Rule 45, will be increased 4 cents per hour, effective May 1, 1919. Steel car workers and other mechanics in the car department who were receiving the rate of 63 cents per hour, under Supplement 4 to General Order 27, will be increased 4 cents per hour, effective May 1, 1919. Other mechanics in the car department who were receiving 58 cents per hour, under Supplement 4 to General Order 27, will be increased 9 cents per hour, making a rate of 67 cents per hour, effective May 1, 1919.

Rule 44. Apprentices, helpers, and other classes of workmen covered by Supplement 4 to General Order 27, except those provided for in Rule 45, will be increased 4 cents per hour above the present rate, effective May 1, 1919. This increase to apply also to men paid on the step-rates provided for in Section 2 and 2a of Article 2, Supplement 4 to General Order 27, except those provided for in Rule 45, effective May 1, 1919.

Rule 45. Linemen and others covered by Rule 141 shall receive 68 cents per hour, effective May 1, 1919. Groundmen covered by Rule 142 shall receive 62 cents per hour, effective May 1, 1919. Coal pier elevator operators and coal pier electric hoist operators as covered by Rule 143 shall receive 55 cents per hour, effective May 1, 1919.

Applicants for Employment.—Rule 46. Applicants for employment will be required to make statement only as to their ability, and address of relatives, except when their duties require them to distinguish signals or do flagging when they shall be required to pass the usual eyesight and hearing tests.

Conditions of Shops, Etc.—Rule 47. Good drinking water and ice will be furnished. Sanitary drinking fountains will be provided where necessary. Pits and floors, lockers, toilets and wash rooms will be kept in good repair and in a clean, dry and sanitary condition. Shops, locker rooms and wash rooms will be lighted and heated in the best manner possible consistent with the source of heat and light available at the point in question.

Personal Injuries.—Rule 48. Employees injured while at work will not be required to make accident reports before they are given medical attention, but will make them as soon as practicable thereafter. Proper medical attention will be given at the earliest possible moment, and employees shall be permitted to return to work without signing a release pending final settlement of the case. At the option of the employee, personal injury settlements may be handled under the provisions of Rules 35 and 36. Where death or permanent disability results from injury, the lawful heirs of the deceased may have the case handled as herein provided.

Rule 49. A place will be provided inside all shops and roundhouses where proper notices of interest to employees may be posted.

Shop Trains.—Rule 50. Existing conditions in regard to shop trains will be maintained unless changed by mutual agreement. The company will endeavor to keep shop trains on schedule time, properly heated and lighted, and in a safe, clean and sanitary condition. This not to apply to temporary service provided in case of emergency.

Free Transportation.—Rule 51. Employees covered by this agreement, and those dependent upon them for support, will be given the same consideration in granting free transportation as is granted other employees in service. General committees representing employees covered by this agreement to be granted same consideration as is granted general committees representing employees in other branches of the service.

Rule 52. Employees will not be required to work on engines or cars outside of shops during inclement weather, if shop room and pits are available. This does not apply to work in engine cabs or emergency work on engines or cars set out for or attached to trains. Should it become necessary to establish a regular night shift in shops, such men will not be used on running repair work unless work is brought to shop. When it is necessary to make repairs to engines, boilers, tanks and tank cars, such parts shall be cleaned before mechanics are required to work on same. This will also apply to cars undergoing general repairs. Employees will not be assigned to jobs where they will be exposed to sand blast and paint blowers while in operation. All acetylene or electric welding or cutting will be protected by a suitable screen when its use is required.

Rule 53. Emery wheels and grindstones will be installed at convenient places in the shop and will be kept true and in order.

Help to be Furnished.—Rule 54. Craftsmen and apprentices will be furnished sufficient competent help, when needed to handle the work, if available. When experienced helpers are available, they will be employed in preference to inexperienced men. Laborers when used as helpers will be paid the helpers' rate.

Rule 55. When dismantling or scrapping engines, boilers, tanks, cars (except wood cars) or other machinery, this work will be done by mechanics of their respective crafts. Sufficient help will be furnisbed. When wood cars are dismantled for scrapping, parts to be removed before car is burned or destroyed will be removed by carmen.

Rule 56. No employee will be required to work under a locomotive or car without being protected by proper signals. Where the nature of the work to be done requires it, locomotives or passenger cars will be placed over a pit, if available.

Rule 57. In shops and roundhouses not now equipped with connections for taking the steam from engines arrangements will be made to equip them so that steam from locomotives will not be blown off inside the house.

Rule 58. All engines will be placed under smoke jacks in roundhouses where practicable, when being fired up.

Rule 59. At shops and roundhouses equipped with electricity, electric light globes and extensions will be kept in tool rooms available for use.

Rule 60. When employees are required to check in and out on their own time, they will be paid one hour extra at the close of each week, regardless of the number of hours worked during the week.

MACHINISTS' SPECIAL RULES

Qualifications.—Rule 61. Any man who has served an apprenticeship or has had four years' experience at the machinists' trade and who, by his skill and experience, is qualified and capable of laying out and fitting together the metal parts of any machine or locomotive, witb or without drawings, and competent to do either sizing, shaping, turning, boring, planing, grinding, finishing, or adjusting the metal parts of any machine or locomotive whatsoever shall constitute a machinist.

Classification of Work.—Rule 62. Machinists' work shall consist of laying out, fitting, adjusting, shaping, boring, slotting, milling, and grinding of materials used in building, assembling, maintaining, dismantling, and installing locomotives and engines (operated by steam or other power), pumps, cranes, hoists, elevators, pneumatic and hydraulic tools and machinery, scale building, shafting, and other shop machinery; ratchet and other skilled drilling and roaming; tool and die making, tool grinding and machine grinding, axle truing, axle, wheel and tire turning and boring; engine inspecting; air equipment, lubricator and injector work; removing, replacing, grinding, bolting, and breaking of all joints on superheaters; oxy-acetylene, thermit and electric welding on work generally recognized as machinists' work; the operation of all machines used in such work, including drill presses and bolt threaders using a facing, boring or turning head or milling apparatus, and all other work generally recognized as machinists' work.

Machinist Apprentices.—Rule 63. Include regular and helper apprentices in connection with the work defined by Rule 62.

Machinist Helpers.—Rule 64. Employees assigned to help machinists and apprentices, operators of drill presses and bolt threaders not equipped with a facing, boring or turning head or milling apparatus, bolt pointing and centering machines, wheel presses, bolt threaders, nut tappers and facers; crane men helpers, tool room attendants, machinery oilers, box packers, grease cup fillers and oilers, and applying all couplings between engine and tenders; locomotive tender and draft rigging work except when performed by carmen.

Assignment to Running Repairs.—Rule 65. Machinist assigned to running repairs, shall not be required to work on dead work, at points where dead work forces are maintained.

Dead Work.—Rule 66. Dead work means all work on an engine which can not be handled wtihin 24 hours by the regularly assigned running repair forces maintained at point where the question arises.

Dead Work and Running Repair Forces.—Rule 67. Dead work forces will not be assigned to perform running repair work, except when tbe regularly assigned running repair forces are unable to get engines out in time to prevent delay to train movement.

Work at Wrecks.—Rule 68. In case of wrecks where engines are disabled, machinist and helper (more if necessary) shall accompany the wrecker. They will work under the direction of the wreck foreman.

Apprentices Classification of Work.—Rule 69. Apprentices shall be instructed in all branches of the machinists' trade. They will serve three years on machines and special jobs. Apprentices will not be required to work more than four months on any one machine or special job. During the last year of their apprenticeship they will work on the floor. Apprentices shall not work on oxy-acytylene, thermit, electric or other welding processes until they are in their last year.

Helper Apprentices.—Rule 70. Helpers who have had not less than two consecutive years' experience as machinist helper at tbe point where employed, at the time application for apprenticeship is made may become a helper apprentice. When assigned as a belper apprentice they must not be over 25 years of age.

Rule 71. Helper apprentices shall serve three years, a minimum of 290 days each calendar year, and sball be governed by the same laws and rules as governed regular apprentices.

Rule 72. The number of helper apprentices must not at any time exceed 50 per cent of the combined number of regular and belper apprentices assigned.

Rule 73. Helper apprentices shall receive the minimum helper rate for the first six months, with an increase of 2 cents per hour for every six months thereafter until they have served three years.

Helpers.—Rule 74. Helpers, when used in any way in connection with machinists' work shall in all cases work under the orders of tbe macbinist, both under the direction of the foremen.

Rule 75. When vacancies occur under classification of macbinist helper (temporary or permanent) machinist helpers in the service will be given preference in promotion to position paying either same or higher rate at station employed, seniority to govern.

Rule 76. Laborers, or similar class of workmen, shall not be permitted to do helpers' work as outlined in Rule 64 if regular macbinist helpers are available.

Differentials for Machinists.—Rule 77. Machinists required to inspect locomotives and swear to reports required by the Federal Locomotive Inspection Law shall receive 5 cents per hour above the minimum rate paid machinists at the point employed. Autogenous welders shall receive 5 cents per hour above the minimum rate paid machinists at the point employed.

BOILERMAKERS' SPECIAL RULES

Qualifications.—Rule 78. Any man wbo has served an apprenticeship, or has had four years' experience at the trade, who can witb the aid of tools, with or without drawings, and is competent to either lay out, build or repair boilers, tanks and details tbereof, and complete same in a mechanical manner shall constitute a boilermaker.

Classification of Work.—Rule 79. Boilermakers' work shall consist of laying out, cutting apart, building or repairing boilers, tanks and drums; inspecting, patching, riveting, chipping, calking, flanging and flue work; building, repairing, removing and applying steel cabs and runnin boards; laying out and fitting up any sheet iron or steel work made of 16 gauge or heavier; (present practice between boilermakers and sheet metal workers on railroads to continue relative to guage of iron), including fronts and doors; grate and grate rigging, ash pans, front end netting and diapbragm work; engine tender steel underframe and steel tender truck frames, except where other mechanics perform tbis work, removing and applying all staybolts, radials, flexible caps, sleeves, crown bolts, stay rods and braces in boilers, tanks and drums, applying and removing arcb pipes; operating punches and shears for shaping and forming, pneumatic stay bolt breakers, air rams and hammers; bull, jam and yoke riveters; boilermakers' work in connection with the building and repairing of steam shovels, derricks, booms, housing, circles and coal buggies; eye beam, channel iron, angle iron and tee iron work; all drilling, cutting and tapping, and operating rolls in connection with boilermakers' work; oxy-acetylene, tbermit and electric welding, on work generally recognized as boilermakers' work, and all other work generally recognized as boilermakers' work. It is understood that present practice in tbe performance of work between boilermakers and carmen will continue.

Boilermaker Apprentices.—Rule 80. Include regular and helper apprentices in connection with the work as defined by Rule 79.

Boilermaker Helpers.—Rule 81. Employees assigned to belp boilermakers and their apprentices, operators of drill presses and bolt cutters in the boiler shop, boilerwashers, punch and shear operators (cutting only bar stock and scrap).

Running Repair Work.—Rule 82. Running repair work for boilermakers shall consist of such boilermakers' work as is necessary to fit locomotive to make a successful trip. It shall include staybolt inspection, ordinary repairs to ash pan and front end nettings, calking and repairing leaks in fireboxes and exterior of boiler tanks. The application of staybolts, patcbes and flues, will be done by dead work forces, but at points where no dead work forces are employed, the roundhouse men will be expected to do such work as will be necessary to fit engine to return to main terminal.

Special Services.—Rule 83. Flange turners, layer outs, and fitter ups shall be assigned in shops where flue sheets and half side sheets or fireboxes are flanged, removed and applied. One man may perform all these operations where the service does not require more than one man. Boiler inspectors—staybolt inspectors will be assigned at all points where monthly staybolts and boiler inspection of 15 or more engines is required. When such employees have no inspection work to perform, they may be assigned to other boilermakers' work.

Protection for Employees.—Rule 84. Boilermakers, apprentices and helpers will not be required to work on boilers or tanks while electric or other welding processes are in use or when tires are being heated, unless proper protection is provided.

Rule 85. Not more than one oxy-acetylene welding or cutting operator or electric operator will be required to work in firebox or shell of boiler at the same time, unless proper protection is provided.

Rule 86. Oxy-acetylene welding or cutting operator or electric operator will be furnished with helper when necessary or when, in the opinion of the operator, it is essential for personal safety.

Rule 87. Should it become necessary to send oxy-acetylene welder or cutter or electric operator out of the shop in cold weather, he will be given ample time to dry off before being sent out.

Rule 88. When it is necessary to renew, remove or replace flue, door, side or crown sheets, by means of oxy-acetylene or other cutting and welding processes, such portion of the ash pan wings and grates as interfere with the operator, will be removed. Dome caps will be removed and front ends opened up if required, for proper ventilation.

Rule 89. Boilers will have steam blown off and be sufficiently cooled before boilermakers or apprentices are required to work in them; blowers will be furnished when possible to do so. Fireboxes, front ends and ash pans will be properly cleaned out before boilermakers or apprentices are required to work in them. Front ends and fireboxes of engines held in for other than running repairs will be washed out before boilermakers or apprentices are required to work in them. Fire brick interfering with the work to be performed will be removed.

Rule 90. Two boilermakers, or one boilermaker and a competent apprentice with at least two years' experience will be used to operate a long stroke hammer: that is, an air hammer capable of driving staybolts or rivets 5/8 in. diameter or larger, or of expanding flues or tubes. Double gun work will not be permitted. When rolling or expanding superheater flues, two boilermakers, or one boilermaker and a competent apprentice with at least two years' experience, will be used.

Rule 91. No tapping or reaming will be done in fireboxes when same is near enough to endanger the men working on inside of firebox. A space of 10 rows of staybolts will be considered sufficient, it being understood that the helper will protect the men with a sleeve over a tap when tapping is being done.

Furnishing Help.—Rule 92. Boilermakers engaged on running repair work will be furnished a helper when necessary, or when it is essential for personal safety.

Rule 93. Boilermakers sent out on the road to do boilermakers' work will be accompanied by helper, when such work requires a helper at home points.

Removal of Fines.—Rule 64. When flues (other than burst flues) are to be removed, the front end will be opened and such parts of the draft appliances as interfere with the boilermaker will be removed. Center arch pipes in engine, other than those equipped with combustion chambers, which interfere with boilermakers in the performance of their work, will be removed.

Helpers on Flange Fires.—Rule 95. Sufficient competent help will be furnished on flange fires.

Rule 96. Helpers on flange fires will not be asked to go outside of shop to handle fuel during cold weather.

Rule 97. Helpers while engaged on flange fires will not be requested to do other work than that in connection with flanging, and, as far as practicable, regularly assigned men will be used on flange fires.

Helpers.—Rule 98. There will be two helpers used in helping a boilermaker or apprentice in breaking down ten or more staybolts with a hand ram.

Rule 99. Classified boilermaker helpers will attend tool room in boiler shop.

Rule 100. Holding on all staybolts and rivets, striking chisel bars, side sets and backing out punches, scaling boilers, and heating rivets (except when performed by apprentices) will be considered boilermaker helpers' work.

Rule 101. When rivets larger than five-eighths inch are to be cut off or backed out, sufficient help will be furnished.

Rule 102. Boilermakers or apprentices, when using compound motors, will be furnished sufficient competent help.

Rule 103. Two helpers will be furnished, when holding on rivets, with wedge bars.

Rule 104. Helpers will do all other work generally recognized as boilermaker helpers' work.

Helper Apprentices.—Rule 105. Fifty per cent of the apprentices may consist of boilermaker helpers who have had not less than two consecutive years' experience as boilermaker helper at the point where employed at the time application for apprenticeship is made. They shall be between the ages of 21 and 40 years and shall serve three years, a minimum of 290 days each calendar year. Helper apprentices shall be governed by the same laws and rules as regular apprentices. Apprentices shall not work on oxy-acetylene, thermit, electric, or other welding processs until they are in their last year. They shall receive the minimum helpers' rate for the first six months, with an increase of two cents per hour for every six months thereafter until they have served their apprenticeship.

Schedule of Work, Regular Apprentices.—Rule 106. The following schedule for regular apprentices showing the division of time on the various classes of work is designed as a guide and will be followed as closely as the conditions will permit.

6 months—heating rivets and helping boilermakers.
6 months—Tank repairing and sheet iron work
6 months—Rolling flues; ash pan work.
6 months—Staybolts and setting flues.
15 months—General boiler work.
3 months—Electric or oxy-acetylene welding.
6 months—Laying out and flanging.

Rule 107. The following schedule for helper apprentices showing the division of time on the various classes of work is designed as a guide and will be followed as closely as the conditions will permit:

6 months—Tank repairing and sheet iron work.
6 months—Rolling flues; ash pan work.
6 months—Staybolts and setting flues.
9 months—General boiler work.
3 months—Electric or oxy-acetylene welding.
6 months—Laying out and flanging.

Differentials for Boilermakers.—Rule 108. Boilermakers assigned as boiler inspectors, also flangers, layers-out, and autogenous welders shall receive 5 cents per hour above the minimum rate paid boilermakers at the point employed.

Rule 109. Helpers on flange fires shall receive 5 cents per hour above the helpers' rate at point employed.

BLACKSMITHS' SPECIAL RULES

Qualifications.—Rule 110. Any man who has served an apprenticeship, or who has had four years' varied experience at the blacksmiths' trade shall be considered a blacksmith. He must be able to take a piece of work pertaining to his class, and with or without the aid of drawings, bring it to a successful completion within a reasonable length of time.

Classification of Work.—Rule 111. Blacksmiths' work shall consist of welding, forging, heating, shaping, and bending of metal; tool dressing and tempering, spring making, tempering and repairing, potashing, case and bichloride hardening; flue welding under blacksmith foreman; operating furnaces, bulldozers, forging machines, drop-forging machines, bolt machines and Bradley hammers; hammersmiths, drop hammermen, trimmers, rolling mill operators; operating punches and shears doing shaping and forming in connection with blacksmiths' work; oxy-acetylene, thermit and electric welding on work generally recognized as blacksmiths' work, and all other work generally recognized as blacksmiths' work.

Blacksmith Apprentices. Rule 112. Include regular and helper apprentices in connection with the work as defined by Rule 111.

Blacksmith Helpers.—Rule 113. Employees assigned to helping blacksmiths and apprentices; heaters, hammer operators, machine helpers, drill press and boltcutter operators, punch and shear operators (cutting only bar stock and scrap) in connection with blacksmiths' work.

Helper Apprentices.—Rule 114. Fifty per cent of the apprentices may consist of helpers who have had not less than two consecutive years' experience in shop on the division where advanced. Seniority shall prevail in the selection of helper apprentices; those selected to be not over 30 years of age. Apprentices selected from helpers shall serve three years, a minimum of 290 days each calendar year. When started as an apprentice they shall receive the minimum helpers' rate of pay for the first six months, at the end of that time they shall receive 2 cents per hour increase and 2 cents per hour increase each succeeding six months while serving their apprenticeship. Helper apprentices shall be governed by the same laws and rules as regular apprentices. If after the first three months, they show no aptitude to learn the tradt, they shall be set back to helping and retain their former seniority as a helper. After completing their apprenticeship, they shall receive prevailing rate paid blacksmiths, if retained in the service.

Rule 115. Apprentices shall be given an opportunity to learn all branches of the trade, and will not be kept on any one class of work longer than four months. Apprentices shall not work on oxy-acetylene, electric or other welding processes until they are in their last year.

Rates to be Maintained.—Rule 116. A rate established on a certain class of work shall remain the same and the men placed on such work shall receive such rate.

Helpers Building Fires.—Rule 117. Blacksmith helpers required to prepare furnaces or build fires on their own time will be allowed 30 minutes straight time for each fire built or furnace prepared.

Running Repair Work.—Rule 118. Regularly assigned blacksmiths and helpers engaged on running repair work located at engine houses will work the same hours as other crafts in engine houses.

Furnace operators and Heaters.—Rule 119. Furnace operators (heaters) will be assigned to operate furnaces making or working material 6 in. or over and heating it for foremen. Heaters will be assigned to operate furnaces used in connection with forging machines 4 in. and over, or to heat any material 4 in. and over to be forged. Heaters will also be assigned to heavy fires. When operators are required on other furnaces, helpers will be used.

Rule 120. Coal and oil suitable for smithing purposes will be furnished at all times.

Rule 121. Competent steam hammer drivers will be furnished.

Rule 122. Blacksmiths sent out on the road to do blacksmiths' work will be accompanied by helper.

Rule 123. Helpers will do all other work generally recognized as blacksmith helpers' work.

Differentials for Blacksmiths.—Rule 124. Blacksmiths working or making material 6 in. or over shall be classified as hammersmiths and shall receive 10 cents per hour above the minimum rate paid blacksmiths at the point employed. Blacksmiths working material 4 in. or over, shall be classified as heavy fire blacksmiths and shall receive 5 cents per hour above the minimum rate paid blacksmiths at the point employed. Heaters on heavy fires shall receive 10 cents per hour above the minimum rate paid helpers at point employed. Hammer operators, and helpers working with hammersmiths or heavy fire blacksmiths shall receive 5 cents per hour above the minimum rate paid helpers at the point employed. Furnace operators (heaters) operating furnaces for hammersmiths shall receive the minimum rate paid blacksmiths at the point employed. Autogenous welders shall receive 5 cents per hour above the minimum rate paid blacksmiths at the point employed.

SHEET METAL WORKERS' SPECIAL RULES

Qualifications.—Rule 125. Any man who has served an apprenticeship or has had four or more years' experience at the various branches of the trade, who is qualified and capable of doing sheet metal work or pipe work as applied to buildings, machinery, locomotives, cars, etc., whether it be tin, sheet iron, or sheet copper, and capable of bending, fitting and brazing pipe, shall constitute a sheet metal worker.

Classification of Work.—Rule 126. Sheet metal workers shall include tinners, coppersmiths and pipe fitters employed in shop yards and buildings and on passenger coaches and engines of all kinds, skilled in the building, erecting, assembling, installing, dismantling, and maintaining parts made of sheet copper, brass, tin, zinc, white metal, lead, black, planished, pickled and galvanized iron of 10 gage and lighter (present practice between sheet metal workers and boilermakers on railroad to continue relative to gage of iron), including brazing, soldering, tinning, loading and babbitting; the bending, fitting, cutting, threading, brazing; connecting and disconnecting of air, water, gas, oil and steam pipes; the operation of babbitt fires and pipe-threading machines; oxy-acetylene, thermit and electric welding on work recognized as sheet metal workers' work, and all other work generally recognized as sheet metal workers' work.

Sheet Metal Worker Apprentices.—Rule 127. Include regular and helper apprentices in connection with the work as defined by Rule 126.

Sheet Metal Worker Helpers.—Rule 128. Employees regularly assigned as helpers to assist sheet metal workers and apprentices in their various classifications of work.

Rule 129 Sheet metal workers shall not be required to remove or apply blow-off or surface pipes or ash-pan blowers on boilers under steam

Rule 130. Sheet metal workers will be sent out on line of road and to outlying points, when their services are required, but not for small, unimportant running repair jobs.

Assignment or Running Repair Force to Dead Work.—Rule 131. The assignment of running repairs sheet metal workers to dead work shall not be the recognized practice; but at points where no dead work sheet metal workers are employed, they may be so assigned if the service requires it.

Assignment of Dead Work Force to Running Repairs.—Rule 132. Dead work forces will not be assigned to perform running repair work, except when the regularly assigned running repair forces are unable to get engines out in time to prevent delay to train movement.

Rule 133. Sheet metal workers will not be assigned to work not applicable to them, except in emergency cases.

Helper Apprentices.—Rule 134. Fifty per cent of the apprentices may be selected from helpers of this craft who have had not less than two consecutive years' experience as a sheet metal worker helper at the point where employed, and shall not be more than 30 years of age; such apprentice shall serve three calendar years, a minimum of 290 days each calendar year, seniority to govern

Rule 135. Helper apprentices will start at the third classification of regular apprentices' schedule when entering their apprenticeship, and continue through as regular apprentices. Helper apprentices will receive the minimum helpers' rate for the first six months, with an increase of 2 cents per hour for every six months thereafter until they have served three years.

Rule 136. Laborers, or similar class of workmen, shall not be permitted to do helpers' work as outlined in Rule 128 if regular sheet metal workers' helpers are available.

Rule 137. Regular apprentices' schedule and division of time:

6 months—Helping.
6 months—Light pipe work.
12 months—Tinning, babbitting and brazing, laying out and forming.
12 months—Engine and car work.
12 months—General work, including one month's experience with the oxy-acetylene torch.

Differentials for Sheet Metal Workers.—Rule 138. Autogenous welders shall receive 5 cents per hour above the minimum rate paid sheet metal workers at point employed.

ELECTRICAL WORKERS' SPECIAL RULES

Qualifications.—Rule 139. Any man who has served an apprenticeship or who has had four years' practical experience in electrical work and is competent to execute same to a successful conclusion will be rated as an electrical worker. An electrician will not necessarily be an armature winder.

Classification of Electricians.—Rule 140. Electricians' work shall consists of repairing, rebuilding, installing, inspecting and maintaining the electric wiring of generators, switchboards, motors and control, rheostats and control, static and rotary transformers, motor generators, electric headlights and headlight generators, electric welding machines, storage batteries, and axle lighting equipment; winding armatures, fields, magnet coils, rotors, transformers, and starting compensators. Inside wiring in shops and on steam and electric locomotives, passenger train and motor cars; include cable splicers, wiremen, armature winders, electric crane operators for cranes of 40 ton capacity or over, and all other work properly recognized as electricians' work.

Classification of Linemen, Etc.—Rule 141. Linemen's work shall consist of building, repairing and maintaining pole lines and supports for service wires and cables, catenary and monorail conductors and feed wires, overhead and underground and all outside wiring in yards. Men employed as motor attendants, generator attendants and substation attendants who start, stop and oil and keep their equipment clean and change and adjust brushes for the proper running of their equipment, switchboard operators, coal in connection with loading and unloading vessels. Electric crane operators for cranes of less than 40-ton capacity.

Rule 142. Groundmen's work shall consist of assisting linemen in their duties when said work is performed on the ground.

Rule 143. Coal pier elevator operators and coal pier electric hoist operators in connection with loading and unloading vessels.

Apprentices Electrical Workers.—Rule 144. Include regular and helper apprentices in connection with electrical workers.

Electrical Worker Helpers.—Rule 145. Employees regularly assigned as helpers to assist electrical workers and apprentices, including electric lamp trimmers who do no mechanical work.

Rule 146. Fifty per cent of the apprentices may consist of electrical workers' helpers who have had two years continuous service at the point where employed. When assigned as helper apprentices, they must not be over 25 years of age, and shall serve three years, a minimum of 290 days each calendar year.

Rule 147. The following schedule for regular apprentices, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as possible:

12 months—Inside wiring and electrical repairing.
6 months—Outside line work.
6 months—Locomotive headlight work.
6 months—Car lighting department.
6 months—Armature winding.
12 months—General electrical work.

Rule 148. Helper apprentices will receive the minimum helpers' rate for the first six months, with an increase of two cents per hour for every six months thereafter until their apprenticeship is completed. If within six months they show no ability to acquire the trade, they will be set back to helping and retain their former seniority as a helper. After completing their apprenticeship they shall receive the minimum rate paid for the work to which they are assigned, if retained in the service.

Rule 149. The following schedule for helper apprentice showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as possible:

6 months—Inside wiring and electrical repairing.
6 months—Outside line work.
6 months—Locomotive headlight work.
6 months—Car lighting department.
6 months—Armature winding.
6 months—General electrical work.

Rule 150. Laborers or similar class of workmen shall not be permitted to do helpers' work as outlined in Rule 145 if regular electrical worker helpers are available

Rule 151. Men engaged in the handling of storage batteries and mixing acid must be provided with acid-proof rubber gloves, hip boots and aprons.

Rule 152. Autogenous welders shall receive 5 cents per hour above the minimum rate paid electrical workers at point employed.

CARMEN'S SPECIAL RULES

Qualifications.—Rule 153. Any man who has served an apprenticeship or who has had four years' practical experience at car work, and who with the aid of tools, with or without drawings, can lay out, build or perform the work of his craft or occupation in a mechanical manner, shall constitute a carman.

Classification of Work.—Rule 154. Carmen's work shall consist of building, maintaining, dismantling, painting, upholstering and inspecting all passenger and freight cars, both wood and steel, planing mill, cabinet and bench carpenter work, pattern and flask making, and all other carpenter work in shop and yards; carmen's work in building and repairing motor cars, lever cars, hand cars and station trucks; building, repairing and removing and applying locomotive cabs, pilots, pilot beams, running boards, foot and headlight boards, tender frames and trucks; pipe and inspection work in connection with air brake equipment on freight cars; applying patented metal roofing; repairing steam heat hose for locomotives and cars; operating punches and shears doing shaping and forming, hand forges and heating torches in connection with carmen's work; painting, varnishing, surfacing, lettering, decorating, cutting of stencils, and removing paint; all other work generally recognized as painters' work, under the supervision of the locomotive and car departments; joint car inspectors, car inspectors, safety appliance and train car repairers, wrecking derrick engineers, and wheel record keepers; oxy-acetylene, thermit and electric welding on work generally recognized as carmen's work, and all other work generally recognized as carmen's work. It is understood that present practice in the performance of work between the carmen and boilermakers will continue.

Carmen Apprentices.—Rule 155. Include regular and helper apprentices in connection with the work as defined by Rule 154.

Carmen Helpers.—Rule 156. Employees regularly assigned to help carmen and apprentices, employees engaged in washing and scrubbing the inside and outside of passenger coaches, preparatory to painting, car oilers and packers, stock keepers (Car Department). Material carriers, rivet heaters (except when performed by apprentices), operators of bolt threaders, nut tappers, drill presses and punch and shear operators (cutting only bar stock and scrap), holding on rivets, striking chisel bars, side sets and backing out punches, using backing hammer and sledges in assisting carmen in straightening metal parts of cars, cleaning journals, assist carmen in erecting scaffolds and all other work generally recognized as carmen helper's work.

Wrecking Crews.—Rule 157. Wrecking crews, including engineers and firemen shall be composed of regularly assigned carmen, and will be paid for such service as per General Rules from time called until return to their home station. Meals and lodging will be provided by the company while crews are on duty in wrecking service.

Rule 158. When wrecking crews are called for wrecks or derailments outside of yard limits, the regularly assigned crew will accompany outfit. For wrecks or derailments within yard limits, sufficient carmen will be called to perform the work.

Inspectors.—Rule 159. Men assigned to inspecting must be able to speak and write the English language, and have a fair knowledge of the M. C. B. rules and safety appliance laws.

Rule 160. Inspectors and other carmen in train yards will not be required to take record, for conducting transportation purposes, of seals, commodities, or destination or cars.

Safety Appliance Men.—Rule 161. Men assigned to follow inspectors in yards to make safety appliance and light running repairs, shall not be required to work on cars taken from trains to repair tracks.

Protection for Repairmen.—Rule 162. Switches of repair tracks will be kept locked with special locks and men working on such tracks shall be notified before any switching is done. A competent person will be regularly assigned to perform this duty and held responsible for seeing it is performed properly.

Rule 163. Trains or cars while being inspected or worked on by train yard men will be protected by blue flag by day and blue light by night, which will not be removed except by men who place same.

One Man Points.—Rule 164. A "one main point" is an outlying point where there is employed one carman, day, and one, night, or where there is only one carman employed. Carmen stationed at one man points shall be paid by the hour and under the rules governing running repair forces, except that the eight hours constituting a day's work may be worked within a spread of ten consecutive hours.

Rule 165. Air hammers, jacks and all other power driven machinery and tools, operated by carmen or their apprentices will be furnished by the company and maintained in safe working condition.

Rule 166. Crayons, soapstone, marking pencils, tool handles, saw-files, motor bits, brace bits, cold chisels, bars, steel wrenches, steel sledges, hammers (not claw-hammers), reamers, drills, taps, dies, lettering and striping pencils and brushes will be furnished by the company.

Rule 167. The application of blacking to fireboxes and smoke boxes of locomotives, in roundhouses, will not be considered painters' work.

Rule 168. When necessary to repair or inspect cars on the road or away from the shops, carmen will be sent out to perform such work. Two carmen will be sent to perform such work as putting in couplers, draft rods, draft timbers, arch bars, center pins, putting cars on center, truss rods and wheels, and work of similar character.

Rule 169. Shops, repair yards and train yards where carmen are employed shall be kept clean of all rubbish.

Apprentices.—Rule 170. Regular apprenticeships will be established in all branches of the trade. Apprentices shall be governed by the general rules covering apprentices.

Rule 171. Apprentices shall not work on oxy-acetylene, thermit, electric or other welding processes until they are in their last year.

Helper Apprentices.—Rule 172. Fifty per cent of the apprentices may be selected from carmen's helpers who have had not less than two consecutive years' experience at the point employed, at the time application for apprenticeship is made. Helper apprentices shall not be over thirty years of age and will serve three years, a minimum of 290 days each calendar year. Helper apprentices shall be governed by the same laws and rules as regular apprentices. Helper apprentices shall receive the minimum helpers' rate for the first six months, with an increase of two cents per hour each succeeding six months until they have served three years. At the completion of their apprenticeship eriod, if retained in the service, they shall receive the mechanic's rate of pay.

Painter Apprentices, Regular.—Rule 173. Regular apprentices—Division of time for painter apprentices.

The following schedule for regular aprentices, painter, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as the conditions will permit:

6 months—Freight car painting.
6 months—Color room, mixing paint.
6 months—General locomotive painting.
12 months—Brush work, passenger equipment.
18 months—Lettering, striping, varnishing, and such laying-out and designing as the shop affords.

Schedule of Work, Painter Helper Apprentices.—Rule 174. Helper apprentices, division of time for painter apprentices. The following schedule for heler apprentices, painter, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as the conditions will permit:

4 months—Freight car painting,
4 months—Color room, mixing paint,
4 months—General locomotive painting,
10 months—Brush work, passenger equipment,
14 months—Lettering, striping, varnishing, and such laying-out and designing as the shop affords.

Regular Apprentices Carmen Schedule of Work.—Rule 175. The following schedule for regular apprentices, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as the conditions will permit. Where sufficient passenger car department work is not available without exceeding the regular ratio of apprentices, in the passenger car department, apprentices will complete their apprenticeship in the freight car department.

18 months—General freight work, wood and steel.
6 months—Air brake work.
6 months—Mill machine work.
18 months—General coach work, wood and steel.

Helper Apprentice Carmen Schedule of Work.—Rule 176. The following schedule for helper apprentices, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as the conditions will permit. Where sufficient passenger car department work is not available without exceeding the regular ratio of apprentices, in the passenger car department, apprentices will complete their apprenticeship in the freight car department.

12 months—General freight work, wood and steel.
6 months—Air brake work.
6 months—Mill machine work.
12 months—General coach work, wood and steel.

Rule 177. In the event of not being able to employ carmen with four years' experience and the regular and helper apprentice schedule not providing men enough to do the work, the force may be increased in the following manner: Regular apprentices who have served two years and helper apprentices who have served two years, may be promoted to mechanics at point employed and will be paid the minimum rate for carmen, seniority to govern. Helpers who have had four or more years' experience at point empolyed, may be promoted to mechanics, they to receive the minimum rate for carmen and be given an opportunity to learn the trade, seniority to govern. The duly authorized committee in each shop covered by this agreement will be consulted and mutual understanding arrived at in promoting helpers. The ratio of helpers to be promoted, to the number of mechanics in any one shop shall not exceed twenty per cent. The general chairman on each railroad affected shall be furnished a complete record of the men promoted. When a reduction is made in force of mechanics, promoted helpers in accordance with their seniority shall be set back first; then advanced apprentices. No mechanics to be laid off until all such promoted helpers and apprentices have been set back. Promoted apprentices and promoted helpers who have not served four years as mechanics, will be set back at any time that mechanics with four or more years' experience make application for employment.

Differentials for Carmen.—Rule 178. Autogenous welders shall receive 5 cents per hour above the minimum rate paid carmen at point employed.

Differentials for Coach Cleaners.—Rule 179. For coach cleaners establish basic minimum rate of 41 cents per hour and to this rate and all rates above 41 cents per hour add 4 cents making a minimum of 45 cents. Coach cleaners to be included in the national agreement and will receive overtime as provided therein.

MISCELLANEOUS

Scope of General and Special Rules.—Rule 180. Except as provided for under the special rules of each craft, the general rules shall govern in all cases.

Effect on Existing Agreements.—Rule 181. In consideration of the standardization of hours of service and rules governing working conditions hereby established on all railroads in Federal operation, the general and special rules of this agreement shall supersede and be substituted for the general and special rules of existing agreements in conflict herewith; rules of existing agreements dealing with conditions of employment not specifically provided for herein shall remain in effect and be recognized as addenda to this agreement by the several railroads who negotiated such rules. Rulings that have been made by the Director General of Railroads and Railroad Board of Adjustment No. 2, where not in conflict with the rules of this agreement, shall remain in effect.

Duration of Agreement.—Rule 182. These general and special rules and regulations shall remain in full force and effect during federal operation unless superseded or amended as herein provided. They shall be printed by the railroads and each employe affected thereby shall be provided with a copy on request.

Revision of Agreement, Etc.—Rule 183. Should either the Railroad Administration or the organizations desire to revise these rules, a written statement containing the proposed changes shall be given and conference held within thirty days to arrange details necessary to negotiate to a conclusion.

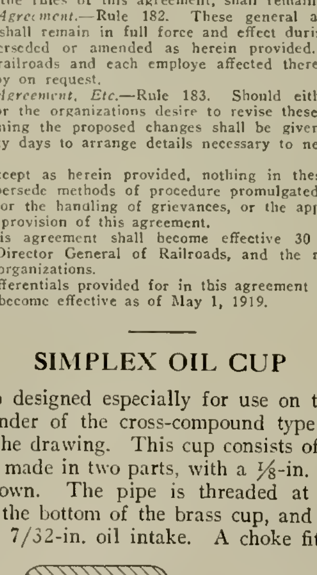
Rule 184. Except as herein provided, nothing in these rules shall be construed to supersede methods of procedure promulgated by the Railroad Administration for the handling of grievances, or the application or interpretation of the provision of this agreement.

Rule 185. This agreement shall become effective 30 days after date signed by the Director General of Railroads, and the representatives of the employees' organizations.

Rule 186. Differentials provided for in this agreement for highly skilled employees shall become effective as of May 1, 1919.

SIMPLEX OIL CUP

An oil cup designed especially for use on the high pressure air cylinder of the cross-compound type of air pump is shown in the drawing. This cup consists of a cylindrical brass casting made in two parts, with a 1/8-in. brass pipe inserted as shown. The pipe is threaded at one end and screwed into the bottom of the brass cup, and the other end is reduced to 7/32-in. oil intake. A choke fitting 5/64 in.



Cross Section of Simplex Oil Cup

in diameter is fitted into the outlet, thus preventing the cylinder from being flooded with oil. These cups require no regulating as they operate only while the air pumps are running, and as the feed is regular and the amount of oil only sufficient to meet the requirement of the pump, they are very economical.

In the cup illustrated old choke plugs from bull's-eye lubricators were used. As will be seen from the drawing, the oil syphons over the bend in the feed pipe, by this means feeding the oil in regular quantities when the pumps are in operation.

THE COST OF BRITISH LOCOMOTIVES

BY ROBERT E. THAYER

European Editor of the *Railway Mechanical Engineer*

Our London contemporary, the Railway Gazette, in a recent editorial criticizes the Egyptian State Railway Administration for spending several thousand pounds for locomotives in America, indicating that the purchases were made without due consideration of prices even though the British concerns quoted prices from 76 per cent to 81 per cent higher than that quoted by the successful American locomotive builder. Its implication was, although they took great pains to forestall any criticism in this respect, that even though the quotations of the British manufacturers were much higher than those of the American manufacturer "the quality of British workmanship and the class of material put into the engines, compared with those produced in other countries, result in an economy in repairs and maintenance and an increased life which more than repay the higher first cost."

The figures quoted as the bids of the British manufacturers were from £15,000 ($63,000)* to £17,000 ($71,400)* with a possible delivery in 1921, as against the American locomotive builder's figures of £8,500 ($35,000)* to £9,400 ($39,500)* with delivery in four months. In other words the Railway Gazette would imply that the workmanship of the British locomotive builders is sufficiently better to warrant the Egyptian State railways paying from $27,000 (76 per cent) to $32,000 (81 per cent) more a piece for their locomotives! We are well aware that the expense of maintenance and repairs should be as carefully considered as the first cost of an article, but at the same time we also believe that the interest on the investment is as important a factor as the cost of maintenance. Figuring money at five per cent, which is an exceedingly conservative rate at the present time, had the Egyptian State Railways purchased their locomotives from the British manufacturers at the quoted figures they would have had additional yearly capital charges varying from $1,400 to $1,600 to apply to each one of these engines.

Before the war, the manufacturers in Great Britain were in a particularly advantageous position as regards the cost of labor. They could economically put more labor in their manufactured articles and produce a product of greater refinement at a much lower cost than was possible in the United States. At the same time the low cost of labor made unnecessary the development and use of the so-called labor saving machinery. During and since the war, however, the cost of labor has increased in Great Britain to such an extent that the cost of the final product when made according to pre-war practice, is greatly increased. America, on the other hand, having had to carefully watch its labor cost has constantly improved its manufacturing methods by the installation of improved machinery, and on the other hand, found it impractical and uneconomical, in the final analysis, to go to the refinement of the British manufacturers.

The real lesson to be learned from the fact that the colonies of Great Britain can buy so much cheaper from America is that greater development has been made in America in the use of improved machinery. It has been repeatedly stated by careful students in manufacturing costs that with the greatly increased cost of labor, both Great Britain and many of the European countries will find it increasingly necessary to improve their manufacturing methods and to use more modern labor saving machinery than they have in the past.

*Based on an exchange rate of $4.20.

RAILROAD ADMINISTRATION NEWS

The Railroad Administration, according to a statement authorized by Director General Hines on November 15, has proposed to the four brotherhoods representing the train and engine employees that in order to give an additional measure of compensation to the employees in the slow freight service, time and one-half will be paid for time required to make their runs in excess of what would be required if an average speed of 12½ miles per hour were maintained, provided, however, that all arbitraries and special allowances now paid in various forms of freight train service are entirely eliminated. The proposal was taken under consideration by the officials of the brotherhoods that have been conferring with Mr. Hines and Railroad Administration officials, with a view to consideration and further discussion. The statement says it is estimated that the net cost of this proposal will be approximately $3,000,000 a month, or $36,000,000 a year.

VOCATIONAL EDUCATION FOR MECHANICS AND APPRENTICES IN RAILROAD SHOPS

For the guidance of railroads contemplating the establishment of schools and classes for training of mechanics and apprentices under provisions of the federal vocational education act and the Division of Operation circular of August 1, 1919, the following additional information on the matter is submitted in a circular issued by Frank McManamy, assistant director of the division:

The federal vocational education act provides that schools organized under its provisions shall be conducted by the particular state in which the school or class may be located, and under the general direction of the state board for vocational education.

It is expressly stated in the act that the controlling purpose of the work to be aided under its provisions is to fit for useful employment those who are preparing for a trade or industrial pursuit or who have entered upon the work of a trade or industrial pursuit.

The purpose for which federal money has been appropriated and may be expended by the state and under what conditions the state may allot such funds is determined in general by the provisions of the law, all details of which will be furnished upon application to the state board for vocational education.

The general conditions for the conduct of the schools set up in the act are as follows:

1. The school or class must be under public supervision or control.
2. The controlling purpose must be to prepare for useful employment.
3. The instruction given in the schools must be of less than college grade.
4. All pupils must be over 14 years of age.
5. To meet the requirements of the vocational education act, the instruction must be given for not less than 144 hours per year. The United States Railroad Administration authorization for 208 hours of instruction per year meets this condition.
6. Every dollar of federal funds must be matched by a dollar of state or local money, or both. The expenditures are to be made by the state board or by the local community, and reimbursement made from federal funds by the state board for vocational education.
7. Reimbursements may be made from federal funds only for money expended for salaries of teachers. This does not include any reimbursement for buildings, equipment, or supplies.
8. The railroad must supply the plant and equipment adequate for the type of instruction to be given. This has

already been authorized by the Railroad Administration in circular issued August 1, 1919.

9. The course of study may include trade drawing, trade science, trade mathematics, and actual shop work. In all cases the instruction given shall be of the trade-extension type, supplementing in character the regular employment of the pupil.

10. The methods of instruction must be such as will insure the functioning of that instruction in the trade which the apprentice is learning. This means that the instruction should be given as far as possible by the individual method rather than through lectures. Demonstrations, illustrations, and examples should be drawn from the shop in which the pupil is employed. A careful coordination must be maintained between the instructor responsible for the related instruction in the classroom and the training which the apprentice is receiving in the shop.

11. All instructors for whose work reimbursement is to be made through the state board for vocational education must be thoroughly qualified and meet the qualifications set up by the state plan in the state in which the work is to be given. The instructor of related subjects should be a man possessing at least two years' technical education of college grade, or equivalent technical education, and having a satisfactory practical experience and contact in one or more of the trades represented in the railroad shop—a contact giving an appreciation and working knowledge of the principal trade processes. It is recognized that whenever a man can be found possessing, in addition to the technical training, a journeyman's experience in a trade, he is more likely to be successful as an instructor.

The Federal Board for Vocational Education, in co-operation with the United States Railroad Administration, will prepare suggested courses of study for at least three trades, namely, machine shop, boiler making, and sheet-metal work, and these suggested courses of study will be placed at the disposal of the various state boards, and through these boards can be obtained by the railroads upon application.

There are certain conditions which should be considered in making arrangements for railroad shop apprentices' schools under this plan:

1. There should be an advisory committee. Such committee may properly include representatives of the workers in the trades, the shop management, and public school.

2. This advisory committee should be responsible for insuring cooperation between the workers, shop management and public-school authorities.

3. The instructors employed for this work should be satisfactory to the advisory committee, as well as meeting the qualifications set up in the state plans.

4. The courses of study should be satisfactory to this advisory committee.

5. The classrooms to be used should be suitably fitted up for the instruction which is to be given, and they should be so located that the apprentices may readily have access from the shop to the classroom and the classroom to the shop without the necessity of making an entire change of clothing or entailing an unnecessary loss of time.

It is understood that railroads may conduct their own schools independent of these arrangements with the Federal Board for Vocational Education, but in such cases the entire expense will be borne by the railroad, and no reimbursement can be made from federal funds under provisions of the federal vocational education act.

ORDERS OF REGIONAL DIRECTORS

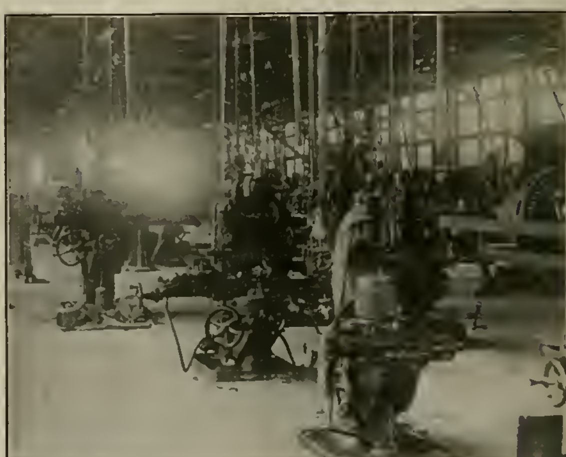
Condition of Locomotive Cabs.—The Northwestern regional director, file 66-1-122, states that the condition of many locomotive cabs is such that in cold weather severe hardships to the men as well as loss of efficiency will result. Openings in cabs around boilerheads, injector pipes, reverse levers and other places must be properly closed; clear vision windows must open and close properly; cab heaters must be applied and be put in proper condition for service, and suitable cab curtains must be provided as soon as needed.

Curtailment of Passenger Service.—The Railroad Administration has made drastic reductions in passenger service in all sections of the country in order to meet the threatened shortage of fuel due to decreased production of coal, which has fallen to less than 50 per cent of normal following the strike of bituminous miners. In the west one-third of the trains were discontinued, in New England 10 per cent were taken off and in the Eastern region practically the same reductions made during the war were again put into effect. The orders in some cases were even more drastic than the wartime restrictions. The Twentieth Century Limited, which had run all during the war was ordered discontinued after December 9.

The order limiting the number of trains in the Northwestern, Central Western and South western regions was issued by P. S. Eustis, chairman of the Western Passenger Committee. It called for the elimination of passenger trains which could be spared with the least inconvenience to the traveling public and the discontinuance of all parlor, club and lounge cars and the elimination of all special trains.

The order reducing the number of trains on the eastern roads was issued on December 5 by A. T. Hardin, regional director of the Eastern region and read in part as follows: "For the purpose of conserving fuel and to protect and provide sufficient transportation, an order has been given for a reduction in train service, effective 12:01 a.m., December 10, on all railroads in the Eastern region. This is necessary not only to conserve fuel, but also to afford the freest facility for expeditious movement of fuel where there may be acute shortages.

"The reduction in service will be general on all roads and will be made so far as practicable on the several lines having common termini, to support each other and afford the maximum service with the minimum number of trains and the least inconvenience to the traveling public. No special trains are to be run for pleasure travel; no second sections of regular trains will be operated except in cases of coach travel to and from cities of dense population, and then only when absolutely indispensable."



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U. S. Army Machine Shop at Gievres, France, Included in the $300,000,000 Sale of Army Supplies to the French Government

STEEL FIREBOXES IN EUROPEAN LOCOMOTIVES

BY W. G. LANDON

Steel fireboxes have not been popular in Europe and in the absence of any other explanation, the treatment the firebox gets in service—in other words, the methods of firing and boiler feeding—may account for this.

Abroad the old fashioned flat ash pan is universal and it is fitted with one or two dampers, which effectually exclude all air when they are closed. The lever controlling the damper is matched, thus permitting a graduated opening. The grates are usually of the fixed pattern. On the Continent shaking grates are used to a small extent but they are so arranged that they do not rock far enough to shake down the fire. Short brick arches are always installed, but arch tubes are not used. The smokebox contains no deflector plate or other arrangement for equalizing draft. Sometimes a netting is arranged around the petticost pipe.

In England boiler feeding is done uniformly on long runs, the injector being left on continuously as in America. Firing intervals are, however, much longer, three to five minutes or more. The practice is to put 10 to 15 shovelsful to a fire and as the grate areas are only 20 to 25 sq. ft., the cooling effect on the firebox must be considerable. All locomotives are supplied with lump coal, which makes this kind of firing possible. Usually the damper is partly closed and a considerable amount of air admitted through the firedoor. The firedoor opens inward on the locomotives of many English railways. In cases where it does not a deflector plate is used, thus driving the incoming air down on the fire. As the fire gets dirty, the damper is opened up and the firedoor closed if necessary. At the running shed or roundhouse, the fire is dumped by knocking out a few grate bars, and the smokebox door is opened and the cinders cleared out. In firing up, natural draft is used and, of course, if the boiler is cool d temperature difference in great is set up between the upper and lower portions of the firebox. Washing out is generally done with cold water, although a few hot water systems have been installed.

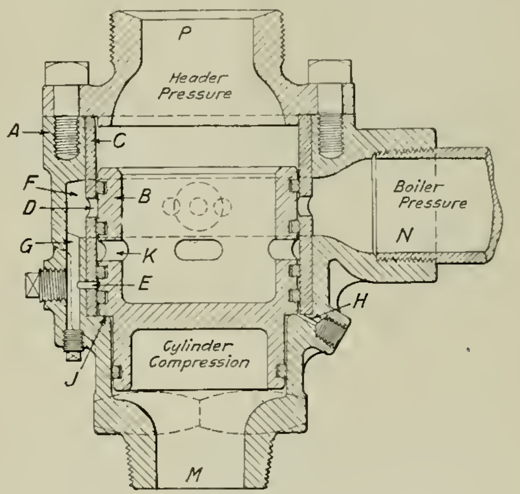
In France the methods are the same, except that injectors are usually over size, so that it is impossible to cut down the feed fine enough for continuous feeding. There is an exception to this—the Paris, Lyons & Mediterranean Railway. Both injectors of these locomotives are on the fireman's side and one is of the proper size for continuous pumping. The idea of the over-size injector originated many years ago, when French engines were supplied with lump coal. Just before firing, the injector was shut off and a large fire put in. Thus the cooling effect of the feedwater would be arrested while the cold air was entering through the firedoor. After the door was closed, the injector was again put on for four or five minutes until firing was again necessary. Now, however, the engines are supplied with coals having a large proportion of slack, so the firing intervals have to be shorter. Consequently the injector is left on for the same length of time, while the firing intervals are reduced to one or two minutes. The slack is wetted down copiously, forming a mush, and siz or seven shovels of this cause a considerable drop in firebox temperature, which together with the excessive amount of feedwater entering the boiler, must cool the lower flues and firebox more than is desirable. The theory of drenching the coal is that although heat is used in evaporating the water, the fusible part of the coal will run and bind the small particles before they are light enough to be lifted from the fire bed, and that the steam escaping from the wet slack forms air passages which assist in combustion. While this theory may have some basis the smokebox of an engine which has been worked on a long run is often nearly half filled with cinders and consequently a large number of the lower flues are plugged up. The firedoor is not left open while running, the draft being controlled by the variable exhaust.

At the roundhouse the fire is cleaned with a variety of implements carried on each engine, the good fire being pulled to the back and covered over, and the clinkers pushed forward. Before the crew leaves the engine, both injectors are frequently put on, thus filling the boiler at a very rapid rate when the fire is practically dead. When the fire is made up the clinkers are pushed out through a dump grate at the front of the firebox.

These practices may be followed occasionally without apparent injury to the boiler, but when they are persisted in the effect must be evident and it would seem that if steel firebox are to be introduced in Europe, some active propaganda on boiler treatment must be conducted.

RIPKEN AUTOMATIC DRIFTING VALVE FOR LOCOMOTIVES

Since superheated steam has come into general use the trouble experienced with deposits on locomotive pistons and cylinders has increased greatly. The use of the drifting throttle has proved effective in eliminating this trouble, but it is difficult to insure that the engineer uses the proper amount of steam and for that reason an automatic drifting valve has important advantages over the drifting throttle. Several types of drifting valves are in use at present, the majority being arranged to come into action when a vacuum is formed in the cylinder. Since the vacuum which operates the valve will also draw in the front end gases which cause



Section Showing the Construction of the Ripken Automatic Drifting Valve

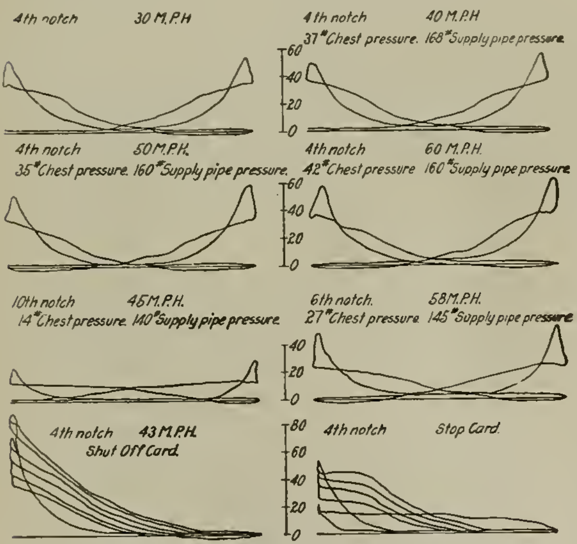
deposits on the cylinder walls, any drifting valve operated on this principle cannot entirely remove the trouble.

In order to do away with the formation of a vacuum in the cylinder a valve has been devised which is operated by the compression in the cylinder. This device is known as the Ripken automatic drifting valve and is in use on the Minneapolis, St. Paul & Sault Ste. Marie. The valve comes into operation before the cylinders are emptied of steam pressure after the throttle has been closed and is kept in operation and furnishes the needed amount of steam until the pistons cease to move. It is automatically closed just as the engine stops by the building up of pressure in the steam chest.

Only one valve per engine is used as the steam is passed directly to the branch pipe or the saturated end of the superheater header. This arrangement is advantageous as it reduces the amount of steam required and also protects the superheater elements against overheating. It is unnecessary to use either air relief valves or by-pass valves in conjunction with the Ripken drifting valve.

The illustration below shows a section of the valve which serves to illustrate its operation. The operating portion consists of a cage *A*, and a differential piston valve *B*. The cage has an opening *M*, at the bottom which is connected by the most direct means possible with one end of the cylinder so that the cylinder pressure is transmitted to the lower side of the piston. The side opening *N* is connected through a two-inch pipe to a live steam line from the turret. The opening *P* at the top of the valve communicates with the branch pipe or superheater header.

Within cage *A* is a bushing *C*, in which are ports *D* and *E*. The port *D* is surrounded by a duct *F*, which is always filled with live steam. From duct *F* live steam passes through the passage *G* to port *E*. At the lower end of the bushing *C* is a small regulating and relief port *H*,



Typical Indicator Cards from an Engine Equipped with the Ripken Drifting Valve

connected by piping to the exhaust chamber of the locomotive.

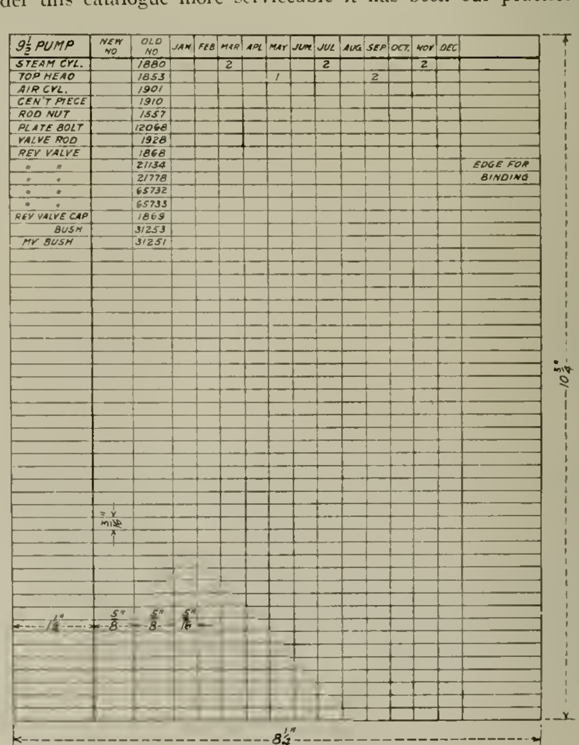
When the main throttle is closed the pressure on top of the differential piston *B* falls and the compression in the cylinders acting on the bottom of the valve being in excess of the steam chest pressure raises the valve *B* off the shoulder *J*, upon which it normally rests, placing the port *K* in communication with port *D*. This permits steam to flow through the valve into the steam chest maintaining the required pressure to prevent a vacuum while drifting. The raising of the valve also uncovers port *E* and the steam entering the annular cavity under the valve is restricted by the port *H* and furnishes the counter pressure necessary to hold ports *D* and *K* in communication until the engine is almost at a standstill. As the speed decreases the pressure in the steam chest will rise, and overcoming the pressure on the bottom of the differential valve, will force the valve to its seat, where the friction of the rings will hold it closed. Any slight leakage past the lower rings is taken care of by the port *H* and it is, therefore, practically impossible for the valve to open while the engine is at rest.

Tests on a superheater locomotive with 25 in. by 26 in. cylinders supplied with steam from a two-inch pipe showed that the valve when adjusted to close at about 40 lb. per sq. in. would maintain between 25 and 30 lb. pressure in the steam chest at 25 per cent cutoff at a speed of 60 miles an hour, preventing the formation of a harmful vacuum even at such high speed. After a shut-off with the reverse lever in running position, the valve would open when the steam chest pressure dropped to about 30 lb. The valve would close again when the steam chest pressure arose to 40 lb. which occurred just before the stop, allowing time for the superheater to empty itself before the engine came to rest. The Ripken drifting valve has been in use nearly two years with excellent results. It has required little attention and has prolonged the life of both the cylinder and the piston rod packing on the engines to which it has been applied.

A CONVENIENT RECORD FOR AIR BRAKE MATERIAL

BY J. A. JESSON

The Westinghouse Air Brake Company's part catalogues are issued in numerical order, and each shop is usually furnished with a complete set in a loose leaf binder. Each sheet illustrates one unit with its accessories, and gives a list of the parts and the numbers of the items. In order to render this catalogue more serviceable it has been our practice



9½ PUMP	NEW NO	OLD NO	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT.	NOV	DEC	
STEAM CYL.		1880			2				2				2		
TOP HEAD		1853					1				2				
AIR CYL.		1901													
CEN'T PIECE		1910													
ROD NUT		1557													
PLATE BOLT		12068													
VALVE ROD		1928													
REV VALVE		1868													
" "		21134													EDGE FOR
" "		21778													BINDING
" "		65732													
" "		65733													
REV VALVE CAP		1869													
BUSH		31253													
MV BUSH		31251													

Stock Sheet Used in Connection with Air Brake Part Catalogue

for some time to insert an extra sheet for each separate device. This covers in an abbreviated form the items which are ordered, and has columns for the name, the old and new piece number, and a separate column for each month of the year, as shown in the sample sheet illustrated above. This provides a daily, monthly and yearly record, all in one book, and has proved useful in checking this material.

CAR DEPARTMENT

THE TANK CAR MAINTENANCE PROBLEM

BY PAUL BATEMAN
Manager People's Tank Line Co., Coffeyville, Kan.

SINCE tank cars constitute a large item of initial expense to almost every producer and marketer of petroleum products, it is of some importance that they be maintained at a point of greatest efficiency with minimum up-keep expense. As an engineer and designer for several years, in the employ of two of the largest car builders in the country, it was a matter of circumstance that one of the outstanding ideas of car builders was forcibly brought to my notice. That is, in substance, design *something different*. The best engineering practice is sometimes made subservient to the principle of designing something on which a claim for a patent may be made.

This practice has resulted in innumerable types of cars,

Fig. 1. Typical Arrangement of Underframe and Draft Gear

each type with its own variations, and has greatly complicated the problem of maintenance of equipment. Repair shops have been called into existence by the impossibility of car owners carrying a sufficient variety of parts to repair their cars properly. Although there are some few concerns which employ experienced repair men, the owners of cars must in general trust to inefficient labor to perform work that requires specialized knowledge and experience. Behind the experience, also, there must be knowledge, not only knowledge of how to make repairs, but of why the part requires repairs and of how to prevent a recurrence of the same trouble. To make this clear we will refer to Fig. 1. showing the end of the underframe of a car. There are innumerable variations in the end structure, but the principle must remain the same in all.

REPAIR OF FRICTION DRAFT GEAR

The yoke, Fig. 1., is riveted to the butt end of the coupler and contains certain friction parts, which, in buffing, are compressed by the coupler against stops, or lugs, riveted to the longitudinal beams, or sills. In pulling, the yoke is brought into play and performs the same duty in a reverse direction, by compressing the friction parts against the front stops or lugs.

When originally installed the friction draft gear is provided with sufficient travel to enable the full capacity of the gear to be utilized. Any shock in excess of the capacity of the gear is absorbed by the horn of the coupler striking against the buffer on the end of the sills, after the gear is compressed to its full capacity.

The gear, as installed, is not at the center of the sills, due to details of construction based on truck clearances, and the necessity of keeping the center of gravity of the loaded car as low as possible and there is approximately a 200,000-lb. shock on a 13 in. to 15 in. girder with an eccentricity of about 4 in. to 6 in. Any shock above the absorption capacity of the gear is absorbed by a direct blow against the fully compressed gear which now acts as a rigid block. When wear on the friction elements develops, the end clearance between coupler and buffer block is eliminated and the impact load in excess of the gear capacity is received by the buffer. The gear, as originally installed, gives protection to the car, but when the friction parts wear, more and more of the impact load is directly transmitted to the buffer. As the latter has relatively little resiliency, it is only a question of a short time before it is broken, thus bringing the full load on the gear and thence directly to the sills. The obvious result is that the sills spread and buckle, or else the rivets on the rear draft lugs are sheared, sometimes both. The usual procedure has always been to say, "Oh, let it ride, the sills are all right, we'll fix it sometime." When it is finally released for repairs the first and only thing done to the car is to put on a new buffer and let the worn-out gear alone.

If the gear has worn so that the first 1½ in. of travel has become non-effective, there will be left only 1¾ in of useful travel of the original 3¼ in. giving a retarding value of only about one-fourth of the capacity of the gear. (Fig. 2.) With the full load of a moving train, having a possible buffing shock up to 1,000,000 ft-lb., it is not hard to imagine the effect on the new buffer casting. This is not an isolated case but is the usual procedure all over the

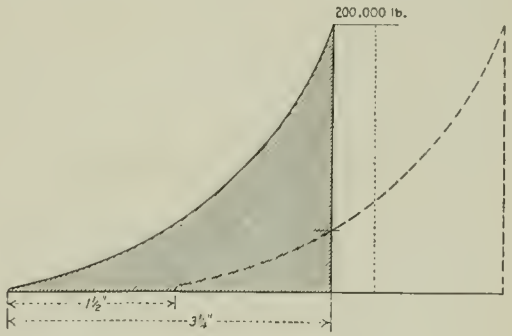


Fig. 2. Diagram Showing Reduction of Draft Gear Capacity with Decrease in Travel

country, not alone with the refiners, but also with the railroad companies and even some of the private repair shops.

In dealing with these buffing forces, kinetic energy must be considered, which does not permit of the same assumption for fiber stresses as in the case of static loads. Under static loads a column can be figured at its full value, with each of the fibers bearing an equal portion of the load. Under these conditions, however, there are two variable forces, one along the center line of the coupler and the other along the center line of buffer impact, the latter after the frictional resistance of the gear has been absorbed. In addition there are the forces compounded by secondary forces which cause torsional stresses. These latter are caused by inequalities of tracks, different heights of couplers, impacts on curved track, couplers being off center, etc. Although termed secondary forces, they are really as much a part of the primary forces as are any others. In tank car designs, it is not necessary to consider the deflection due to loading on account of the loads usually being concentrated at the bolsters and thence transmitted directly to the truck, so the sills bear only the compound load which is due to the conditions previously mentioned.

The above case, as illustrated, is indicative of the usual methods employed in making repairs. No thought is given to the cause. The best way to make repairs, of course, is to prevent the necessity. However, in conditions as they are, the best procedure is to remove the slack travel of the coupler by renewal of necessary parts and by placing shims between the gear and the lugs. After that, see that the correct position is maintained.

TRUCK REPAIRS

Reference to Fig. 3 shows the usual design of arch bar truck construction and the lines of force with their attendant results. We will suppose a loaded car to be in a rapidly-moving train, when an emergency application of the brakes is made. The braking power is from 70 per cent to 90 per cent of the light weight of the car which, in a 38,000-lb. car of 8,000 gal. capacity, loaded with gasoline, is 30 per cent to 40 per cent of the total weight of the car. The result is that the trucks receive a direct load at the center plate due to the inertia of the entire loaded body of the car at whatever speed it is traveling.

It has seemed inconsistent that one part of the car—the sills, through the coupler—should be used to start the car, and another and much lighter part—the brakes operating on the trucks—should be used to stop it. The writer sees no way, at the present time, to improve the basic principle of this.

The resultant tendency in brake application is to transmit a load to *one* side of the center plate and generate torsional stresses tending to rotate the bolster. This load very naturally comes on only one side of the truck springs, which are intended always to act as a unit. The result is that the springs compress unequally and throw the bolster against the columns with unequal bearing. This causes failure in the columns by tearing the column bolt through the wearing surface of the column. A condition of this kind is usually caused by neglect in allowing nuts of column bolts to become loose, thus permitting the arch bars to spread and allowing excess clearance. Quite frequently the cars, as originally built, have entirely too much clearance.

The material wear of the column guides on the bolster should be taken up by placing shims on one column or else on the column guide on the bolster. This is almost never done as it requires that the truck be practically dismantled. Another cause of trouble is the rapid rounding of curves at which time the loaded car seeks a tangent and the trucks must follow the rails. That causes the bolsters to exert more pressure on one set of springs than on the other, thus allowing the springs to slip and quite frequently lose out. Improper side bearing spacing and clearance are very usual causes of truck failure and are also often responsible for derailments.

The principal instructions would seem to be to keep the truck tight and see that the wooden shims, above or below springs, are renewed at sufficient intervals to insure that they are solid. These shims are made of seasoned oak but they decay very rapidly and allow the springs to settle into them, thus increasing clearances to an unsafe margin. Side bearing clearances must be kept at the proper point, 1/8 in. to 1/4 in. between top and bottom.

REPAIR OF TANKS

Of the tanks proper little need be said except that all *indications* of leaks should be immediately looked into as stains on the outside usually mean that the caulking edge of the sheets and rivets on the inside has deteriorated. The tank should not only be caulked on the outside but more especially on the inside. It might be stated that caulking on the inside is almost never practiced except in the shop where its necessity is understood. The fact that inside caulking is obligatory, under Bureau of Explosives' Rules, seems to be overlooked. Leaks are quite commonly caused by deflection

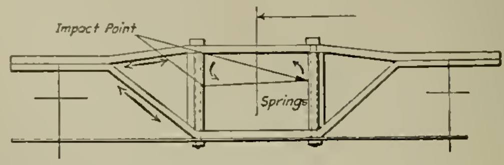


Fig. 3. Forces Acting on Arch Bar Truck

of the sheets of the unsupported end portion of the tank which causes distortion of the sheets at riveted joints.

The safety valves ordered to be used have always been a source of wonder to the writer, particularly as to why it seemed necessary to provide 40 sq. in. of safety valve outlet surface while the largest locomotive using superheated steam and a pressure of up to 250 lb. per sq. in. has only about 10 per cent of this area. The Master Car Builders Association has designed a device using a spring balance to determine the proper point at which to set the valve. Inequalities of bearing surface on the valve seats seem to be overlooked, consequently there is practically no guarantee that the valves will hold any pressure whatever. All valves should be removed and ground in with emery in oil, then set to the proper point under a test by compressed air. The valve question is not only a maintenance problem but one in design, which it is to be hoped will have the attention of qualified engineers.

The advisability of keeping cars well protected by paint is too well known to require more than passing comment. That comment is mostly directed toward the policy of merely making the cars a good advertising sign board instead of seeing that the painting is properly done. Cars, particularly the tanks, should be thoroughly cleaned preparatory to painting as the improperly cleaned car will not held the best paint made. The company with which I am connected has found it advisable to put the problems of painting up to the paint manufacturers, using their knowledge and experience in connection with our own.

One of the greatest causes of tank cars being neglected is the attitude of certain railroads, particularly at competitive points. When an inspector refuses a "bad order car," a competing road's inspector will take it and so drum up business for his road. If it is impossible to run the car in its condition as accepted, temporary repairs are made. In fact, anything is done that will get it out of the yard at the point of origin. The owner is very grateful to the railroads accepting the car and consequently the accommodating railroad gets the future business.

This policy can have only one result, and that is evident when it is stated that the policy is pursued in endless chain fashion, the original road accepting cars that even the first offending road refused to handle.

Delegates to the Convention of Car Inspectors and Foremen.

Car Inspectors and Foremen Meet

Continuation of the Discussion of the Changes in the Rules of Interchange; Other Business

A REPORT of the preceedings of the opening session of the nineteenth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association was published in the October issue of the *Railway Mechanical Engineer*, page 593. This included a discussion on Rule No. 2, at the close of which a committee was appointed to consider the wide diversity of practice in interpreting this rule in different sections of the country and report later to the convention. The following report was later submitted and adopted unanimously: "The committee does not feel it consistent with the basic interest and purpose of this rule and the decisions given thereon by the administration that we should recommend any changes in the application of the rule other than the proper supervision by those in authority at the several terminals and interchange points, consistent with local conditions, more especially on point of inspection and repair track facilities."

Following the discussion on Rule No. 2 the association proceeded to the consideration of the changes in the rules as recommended in the report of the Arbitration Committee presented at the 1919 convention of Section III, Mechanical. An abstract of a portion of the discussion of the rules under this head was published in the October issue. Only a part of the rules was covered, however, and a more complete abstract of the discussion of all of the rules is given below.

RULE 32.

(Delivering company responsible.) Dome cover or safety valves missing from tank cars. Material missing from cars due to handling on unloading machines. Removing or cutting out parts of car to facilitate loading or unloading. Known theft of parts of car occurring on handling line. Damage to any car (including cars on ferries or floats) if caused by: (a) derailment, (b) cornering, (c) sideswiping, (d) collision or impact other than that occurring in regular switching, (e) handling of cars with broken or missing couplers, or couplers out of place, (f) colliding with or shoving over bumping posts or other fixed obstruction, (g) shifting of loads from other cars, (h) overloading, (i) explosion, (j) collapsing buildings or other structures on right-of-way, (k) unconcealed fire damage (l) flood, (m) storm where car is derailed or destroyed, (n) failure to close hopper or drop doors before moving car.

T. S. Cheadle: I would like to know if any trouble is experienced with the shifting of loads?

F. C. Schultz: It is our practice to charge the delivering line for any damage on account of improper loading or shifting of the lading.

T. J. O'Donnell: Have any of you considered what the Arbitration Committee means by "impact." Wouldn't that run into the combination of defects?

F. G. Schultz: If a car is damaged in a collision with a number of cars in a train, it is not an owner's responsibility.

J. C. Keene: (Wabash) Unless the car is derailed, cornered or sideswiped, the owner is responsible.

F. C. Schultz: I think this was changed to take care of a case where a private line car was broken entirely in two and there was no evidence of derailment.

T. J. O'Donnell: If investigation showed the damage occurred in connection with an accident, it would be straightened out.

N. Marple: (M. C.) I am a member of an O. S. & D. committee and am watching all cars that come in on the repair track to ascertain the condition of the lading. Cars have to be opened to make repairs to draft gears, and 90 per cent of them have the loads scattered all over the car and the draft gear damaged. Therefore, we want to be careful in what we say is ordinary switching.

T. S. Cheadle: Regular switching service on one road isn't regular switching service on another. I would be glad if we could get an idea of just what that term means as commonly used.

H. W. L. Porth (Swift & Co.): I think the intention was to clarify the terms wreck and fair and unfair switching. It is a matter of judgment as to the damage done to the car. Under the old term, the case brought up was a private line car that had been demolished in unfair switching, but the trucks of the car had not left the rails, hence there was no derailment. The intent of the rules is fairness and judgment of course must enter into the interpretation of these rules.

G. Lynch: The term "wreck" has been eliminated and "collision, impact and regular switching" substituted. If impact is to be considered we will have a great deal of damage done by impact because we must couple automatic couplers by impact.

T. J. O'Donnell: Isn't it fair to presume that this rule is a help to us? We had nothing to guide us before.

G. Lynch: We had owner's responsibility for all missing parts of a car in fair service, and we had Rule 32 which covered unfair usage.

J. P. Carney (M. C.): That rule is to get rid of the old, weak equipment and make the owners responsible.

F. H. Hanson (N. Y. C.): You are not going to be able to tell whether the car was moving 5 or 20 miles an hour. I think we should go on record as saying the owner was responsible unless the car was derailed, sideswiped or cornered.

President Stoll: In the absence of any proof that the car was in a wreck, how can it be proved when the car is delivered to the other road in interchange? If the railroad is honest, it is an easy matter.

C. M. Hitch: This rule is plain enough, I believe, if we are all fair. A man who is guilty of damaging another man's car knows whether he is responsible or not; let him comply with the rules and card the car; he knows whether it was fair switching or not. If a cut of cars runs down without a rider and smashes a car, I would call that unfair switching.

A. Armstrong: I know less about Rule 32 now than I knew when I left home and an explanation will be expected of me when I return. I would like to ask an interpretation of this rule.

W. S. Elliott (St. Louis): Mr. Carney brought the situation out very clearly. There are times when a weak car is broken in two. There is another case where a car is in good condition and 10 or 12 loads of coal are dropped down against it. That is not regular switching.

G. Lynch: If anyone can tell me what a collision is and what a wreck is, or can tell me what impact is, I would be very glad to get a definite understanding of these terms.

W. S. Elliott: It seems strange that the chief interchange inspectors should disagree on this rule. It is not a new condition with us. On the steel cars we have had practically the same rule. I have had to call Mr. Halbert over time and again to verify my judgment on whatever the case might be. Where there is a chief joint inspector, there should be no trouble. You ought to be able to know what reasonable switching is. I take a fair and liberal interpretation of it and do not anticipate any trouble at all.

M. W. Halbert (St. Louis): The only contention I see is on collision or impact. The chief interchange inspectors at large interchange points inspect all cars that are damaged sufficiently to require carding. The only thing we can do is to use good broad judgment and treat both companies fairly in making a decision. When a car is broken in two you can invariably detect evidence to show whether the damage was done in ordinary switching or rough usage. As chief interchange inspector, I make a decision, and it is up to the road that gets the car to protest afterwards. If it is decided I am wrong there is no harm done. I always try to give the receiving line and the delivering line the best of my judgment. If we make a mistake, let the Arbitration Committee correct us.

E. H. Wood (M. C.): Rule 32 is as clear as water. It shows us how to get rid of a lot of old equipment that should not be in service at all. If a car wont stand up in regular switching, it should be taken out of service.

F. H. Hanson: I move that it is the sense of this association if cars are broken in two, but the trucks do not leave the rails, the owner will be held responsible if there is no evidence of derailment, cornering or sideswiping.

The motion was seconded and carried.

G. Lynch: In regard to missing cross braces, before it was owner's responsibility. Now there is a line drawn there. Damage caused by unloading machines is delivering lines responsibility. That should be made clear.

T. J. O'Donnell: Don't you make the owner responsible for a missing hopper door; aren't we safer with this rule?

G. Lynch: The owner will contend that it was removed.

T. J. O'Donnell: Sometimes when opening hoppers the doors are broken or torn off. Those are cases where the Arbitration Committee is trying to protect the owner. It is better to be liberal than technical.

F. C. Schultz: Who can decide whether the material has been actually stolen or thrown away?

G. Lynch: At Cleveland there are six coal loading machines where cars are unloaded into boats. The inspection does not determine whether the inside cross braces are missing or not. They may be missing. The car is returned to the delivering line and these inside braces are found missing and there is a possibility that they were missing when the car was offered in interchange. Is the unloading road to be made responsible for the missing parts? How are we to decide on the interchange track or when cars are found on the repair track damaged, when there is no other damage to the car?

A. Berg (N. Y. C.): Shippers use clam-shells and other devices for unloading or dumping cars. It was felt that if the road that delivered the car was made responsible they would take steps to prevent industries unloading cars from damaging the equipment. The rule will accomplish just what was intended.

T. J. O'Donnell: I think Mr. Berg has struck the keynote.

J. S. Naery (C. I. & L.): A missing inside brace is a small item but bolsters are also borken on unloaders.

C. M. Hitch: I have seen a great many cars handled on dumping machines but I never saw a truck bolster or body bolster damaged. If that condition prevails there is a weakness in the construction of the bolster.

H. A. Lightner (I. C.): As to missing parts when the car is unloaded, you would to be able to determine whether the part was missing when the car was loaded or was damaged in unloading.

RULE 33

Owners will be responsible for the expense of repairs to safety appliances where not involved with other delivering line damage, except damage to running boards on tank cars when sideswiped or cornered.

F. W. Trapnell: Under the present rules in some parts of the country, defect cards are being secured for running boards on tank cars that have been cornered and sideswiped that have no other delivering line damage. I cannot see how they can be furnished under the rule.

T. J. O'Donnell: The old rule does not give any authority to handle it on that basis.

F. C. Schultz: If the ladder on the end of a car is bent, it is owner's responsibility, but when the car body is damaged as well it is delivering line responsibility. The construction on a tank is such that the running board is invariably broken.

F. W. Trapnell: Rule 33 now exempts running boards from owner's responsibility because they are safety appiances. I believe that is a reasonable exemption. If it was not owner's defect before this recommendation came in, why the necessity of making this recommendation?

H. W. L. Porth: We have had cases of cars coming into our yard with grab irons entirely broken and no evidence of any defect or damage to the car that could be carded, although the safety appliances were damaged beyond repair.

A. Herbster: The Arbitration Committee does not feel that a running board on a tank car can be damaged in fair usage and, therefore, makes it a delivering company responsibility.

T. S. Cheadle: A tank car with a running board damaged is a delivering line responsibility under the new rule, but a car other than a tank car with the running board or safety appliances damaged is owner's responsibility.

RULE 66.

(Owners responsible.) Periodical repacking of journal boxes, regardless of the responsibility of delivering company for change of wheels, journal boxes or journal bearings. No charge shall be made for repacking unless all boxes are repacked. No charge shall be made if the repacking is done within nine months from date stenciled on car. If car bears no stenciling, showing date of previous repacking, all journal boxes may be repacked, if necessary, and charged for.

(a) All journal boxes shall be repacked with properly prepared packing (new or renovated) at least once every twelve months, at which time all packing will be removed from the boxes and the boxes cleaned; dust guards to be renewed when wheels are changed.

(b) The date and place (railroad and station) where the work is done must be stenciled on the car body near the body bolster at diagonal corners in 1-in. figures and letters, using the same station initial that is used for air-brake stencil.

(c) This work to be done as far as possible when cars are on repair track undergoing heavy repairs. When on repair track for heavy repairs, cars which have not had boxes repacked within nine months will have all boxes repacked and the record stenciled on the car as above.

(d) This does not contemplate any change in the intermediate packing of boxes when it is necessary to do so. No change should be made in the stenciling unless all boxes are repacked.

J. J. Gainey: What is meant by repacking boxes? Is it intended to remove all the packing and take it to a vat and renovate it, or just have a man who goes around with a pan, put it in the pan and shake it out and put it back in the box again? Fifty per cent are doing it that way with unsatisfactory results.

J. C. Keene: If that is being done it ought to be corrected. The packing should be taken to a renovating plant and thoroughly renovated and returned. Either new or reclaimed packing can be used as desired.

T. S. Cheadle: It is not proper to render a bill under Rule 9 unless renovated or new packing is used.

J. C. Burke (U. P.): The rule states plainly that new or renovated packing must be used.

C. M. Hitch: This is one of the best rules that has been passed. I certainly would not render a bill if the boxes were not repacked in accordance with instructions, but I will use reclaimed packing the same as new. It should be understood that in cases where all boxes on a car are not repacked, no bill is to be presented.

N. Marple: The cost of performing the work is greater than charge allowed under the rules.

RULE 88.

In order that repairs of owners' defects may be expedited as fully as possible, foreign or private line cars may be repaired by the handling line by using material from their own stock instead of ordering material from car owner, as prescribed by Rule 122, in which event the repairing line must issue its defect card for the labor only of correcting such improper repairs, and defect cards should be so marked.

In case of delivering line defects, defect card shall be issued for both labor and material for correcting the improper repairs.

N. Marple: Are there any private car owners here who can state whether it is the practice, when cars that have been repaired come home, to tear the work down to see that the repairs are done properly.

A. Herbster: I have been in one shop that made it a practice to tear out everything that railroad repair men put on the car; it was not a large corporation.

N. Marple: We all want to play fair as near as we know how, but even when we make repairs as near like the original construction as we can, we get joint evidence cards showing wrong repairs were made.

F. C. Schultz: I believe it is advisable for the railroads to return private line cars to the owners for repairs as the average railroad repair shop is not equipped to make proper repairs to these specially constructed cars.

F. W. Trapnell: The private car owners must know that the car is in shape to carry the contents to its destination with proper icing. We have discouraged making any repairs to wrecked refrigerator cars and are sending the cars to the owner's plant.

J. J. Gainey: A railroad company can repair a refrigerator car properly. We had a refrigerator car in a while ago, and I gave instructions to have the car absolutely perfect when it went home. Every day I looked to see what work was being done on it. The car went to an interchange point and joint evidence was issued for 3¼ in. roofing instead of 5¼ in.; joint evidence also covered lemon color instead of a deep orange. The joint evidence card came back from our staff officer and I wrote to the owners. They stated that all they were going to ask for was a card to change the color. In ten days no one could have told one color from the other.

N. Marple: You have to make the car safe to go home and you are losing all the money that you expend on temporary repairs.

H. W. L. Porth: There is a difference between an ordinary refrigerator car and one that has to carry beef. It has been my experience that in most cases cars are returned when in need of repairs, and the private lines in general encourage this practice as they prefer to do the work themselves.

J. J. Gainey
First Vice President

W. J. Stoll
President

J. C. Keene
Secretary-Treasurer

RULE 95.

In reference to a recommendation that this rule be changed to include missing brake beams and other brake details, as formerly covered, the Arbitration Committee recommends the rule remain as at present for the reason that in case of bill for defective or missing brake beams, the average credits allowed under Rule 101 are high enough to offset the value of occasional missing beams, and the billing is thereby greatly simplified. Furthermore, the condition of the missing beam cannot be ascertained and is no doubt frequently defective.

T. S. Cheadle: Would it be proper to issue a defect card if the brake beam was on the line delivering the car?

President Stoll: Look at the changes made by the M.

C. B. in 1918 and you will find that a missing brake beam is owner's responsibility.

J. C. Keene: The price allowed for the beam was made to take care of the condition.

A. Herbster: I do not believe there are enough missing brake beams in interchange to argue about. Repairs are almost invariably made by the company on whose roads the car becomes defective.

RULE 108.

No labor to be charged for the inspection of cars, testing or adjusting brakes, adjusting angle cocks, tightening unions or spreading cotters; still steps, ladder treads or handholds, tightening or straightening on car.

No material or labor to be charged for the following items of repairs: 1. Air-hose gaskets, applied, except with hose complete, applied. 2. Brake pins or key bolts, applied. 3. Brake ratchet wheel keys, applied. 4. Brake-shaft rings, applied. 5. Brake-shoe keys, applied. 6. Carrier iron, Bettendorf type, when turned over, no charge for adjustment. 7. Coupler release clevises, clevis links or chains, clevis pins or bolts, applied. 8. Lag screws, applied except when used to complete other items of repairs not herein listed. 9. Nuts or lag screws, tightened. 10. Nuts, ¾in. or less, applied, except when used in renewal of bolts. 11. Nut locks, or lock nuts, applied. 12. Release-valve rods, repaired or applied. 13. Straightening brake shafts and uncoupling levers when not removed from car. 14. Spring cotters and split keys, applied. 15. Staples, applied. 16. Wood screws, applied, except when used in renewal of running board. 17. Washers, applied, except when used in renewal of bolts.

No charge to be made for the material or labor of lubrication, except as provided in Rule 66.

N. Marple: Do you not think that minor items of repairs on which no bill is to be rendered under the rule will be neglected especially in train yards?

President Stoll: The general opinion was that the items of repairs referred to were necessary from a safety standpoint and would be taken care of.

CIRCULAR 25, RULE 8.

In compliance with the recommendation of the Interstate Commerce Commission in Case No. 4906, "In the Matter of Private Cars," a second paragraph is added to Rule 8, effective April 1, 1919, as follows.

When repairs of any kind are made to cars of private ownership where such cars are equipped with suitable receptacle, a copy of the billing repair card shall be inserted in such receptacle. The loss of such card from the receptacle referred to, will not invalidate bill for the repairs. This receptacle to be applied by owner at any convenient location on car, provided the location selected will not require inspectors or repairmen to go underneath or between the cars.

C. M. Hitch: In many places the M. C. B. repair data is furnished by the inspectors and their books are sent to the foreman's office. The inspector should be enabled to place a repair card in the receptacle at the time. The best way to handle that would be to have an extra copy of the repair card made and mailed to the owner of the car.

M. W. Halbert: There are only a few private cars being equipped with repair card receptacles.

A Member: Why should the private line car be given more consideration than a railroad car, or why should we be required to put the repair card in that receptacle?

A. Herbster: That was recommended due to the fact that private cars come home more regularly than railroad cars and the owner can check the card with the actual repairs made to the cars, but I do not believe that it has met with the result that the car owner anticipated.

INSPECTION OF LOADS IN OPEN TOP CARS

A question was raised as to the advisability of inspectors making records of depressions in loads shipped in open top cars in order to eliminate leakage enroute and to protect the railroads in case claims for shortage are filed by the shipper. The discussion brought out that at most terminals the inspectors who examine the roofs of the cars are required to note any apparent shortage. A report is made to the agent and the cars are weighed to determine the loss of contents and to establish the amount occurring on each line in case the shipment is hauled over more than one road. In general, if the road does not transfer the load it must participate in any expense due to loss of lading.

UNIFORM INTERCHANGE INSPECTION RECORDS

President Stoll: I received a communication from one of the large interchange points asking me to bring up at this meeting the possibility of making the records of inspection uniform at all large interchange points.

T. J. O'Donnell: Under our present method of inspection in the receiving line yard, there are certain roads that take only the numbers of the defective cars. There are other roads that take the numbers of all cars. I think it is decided if bad order cars are shown that those that are not shown are O.K. We are throwing money away to take the initials and numbers of the good order cars, and I feel that it would serve the purpose for interchange throughout the country, if only the bad order cars were noted.

J. C. Keene: The question was not as to what cars would be recorded, but to adopt some sort of a standard record. At one point a book is used, at another a sheet and at another a card form. It is my thought that we should adopt a standard form of interchange record similar to the interchange sheet which the transportation department has adopted and which accompanies delivery of cars to the other lines. Our road reaches several division points and at no two points do they have the same kind of record or form sheet.

I would recommend the appointment of a committee to look into the matter and report at our next convention. It will take considerable time to go over this subject and I believe that that committee should confer with the car service men or car accountants. We find that in a period of six or seven days there will be as many as 75 errors made in interchange and that the car inspector is usually correct. A great many movements of cars in interchange are lost because of the fact that the roads fail to get the proper record. We feel that the interchange sheets should be checked against the car inspector's record.

F. W. Trapnell: There isn't any more important record for a railroad than the car inspector's record when properly made and if, as a body, we could devise some suitable blank that could be used at all interchange points, we could accomplish a great deal. We use the car inspector's record to verify the agent's record and when we find a discrepancy, we take the car inspector's record in preference to the agent's because the agents sometimes get the seal number in place of the car number.

Secretary Smith: It seems to me that a uniform record is a desirable thing to have, but I do not like the idea of putting all the work on the car inspector. In many places he takes the number of all cars that are interchanged, but in a great many more places he does not take the record of any cars except those to which he takes exceptions, as defective. If we are to recommend a blank which compels the car inspector to write the number of every car that passes through interchange, it is going to put some work on him. He is too busy and besides he is too highly paid to just take car numbers.

F. W. Trapnell: I believe the railroad companies ask that all cars in interchange be recorded by the car inspector. We have no trouble and we interchange several hundred cars a day.

A. Herbster: The elimination of the record of car numbers and initials on all cars was primarily started in order to get the inspector to make more repairs and do less clerical work.

F. H. Hanson: A great many roads have issued instruction to inspectors not to take the numbers and initials of good order cars. The agent has a complete record of all cars interchanged and we are carrying out the instructions of the administration in reporting bad order cars only.

B. M. Waldo (Dallas): We are taking a record of cars that are defective only, but we really would rather take a record of every car. It is embarrassing when the claim agent comes for a record. As long as they depend on us for a record we ought to have something on file from which we can answer the questions. The car inspectors have a great deal of work to do, and I appreciate all that has been said, but I am in favor of keeping a record of all cars interchanged. It is a small matter to take down the number and initial.

J. C. Keene: I had a little experience on the question of abrogating the taking of the initial and number of all cars in interchange. Where that practice is followed there is no record whatever to protect your department. To illustrate: in going through the yards, I found two or three cars in bad order, showing defects that should have been detected on interchange inspection. The inspector had nothing in his book on these cars and he answered me: "I cannot tell you whether I inspected these cars or not. Perhaps the switch engine got hold of them and took them away. Perhops they were placed on another track when delivered." Unless the inspector has the number and initial he cannot go in any court and make an affidavit that he inspected the car and found it O.K.

President Stoll: Nine years ago the car men of the different railroads at Toledo decided to have the inspectors take a record of all cars. Just before the government took over the railroads they decided to eliminate it. Then the terminal manager took over the bureau and said he wanted a record of all cars taken and the order was put into effect again to take all car numbers. The sheet has been beneficial, not so much to the car department as to the other departments, especially the claim department. Men come from Columbus and Cincinnati to look up records of cars that have been interchanged to fix responsibility, and in every case where the company did not have a record they fixed their claims accordingly. For the good of the service, I believe it is advisable to have a record of all cars.

A. Kipp: That question was taken up on our road five years ago. Our law department prior to that time expected the car inspector to take the number of every car so that he might be able to go into a court and swear as to whether he inspected that particular car, but after two or three years, they decided that it would be better for the car inspector to have a closer inspection and make more repairs and do less clerical work.

E. Head (Wabash): The thought has occurred to me that we will get back to the time when the roads will be in the hands of their owners and a fine will be imposed for penalty defects. We have had suits entered against roads for penalty defects and the record was one of the most important things in the case. Where we did not have a record of the car number and initial the court ruled we had no record and that omission cost us $100.

A. Herbster: If an accident happens it is the actual condition of the car and not the previous inspection record of the inspector that governs.

T. S. Cheadle: Various methods are used for obtaining records. I do not require any record to be kept except of the bad order cars.

On motion the Association authorized the appointment of a committee of five to approve or present to the association at its next regular session for approval a blank form of car inspector's record of cars inspected at interchange points. A committee was appointed, consisting of F. W. Trapnell, T. J. O'Donnell, A. Kipp, A. Armstrong and F. C. Schultz.

ADDRESS BY A. E. BOUGHNER

At the session on Thursday morning, an address was delivered by A. E. Boughner, superintendent of the Missouri, Kansas & Texas, and chairman of the Interchange Committee of St. Louis, Mo. Mr. Boughner said in part: The terminal facilities of St. Louis for the interchange of traffic are really not very good and it has required a united effort on the part of all concerned to keep the business moving. The different avenues choke up very quickly and for that reason rules have been worked out here to always keep cars going forward. They seldom go backward. Some of the government requirements demand that cars with certain defects move backward. Outside of that we do not figure on anything moving back in St. Louis. I believe at the present time an immense amount of good has been brought about and a lot of money has been saved, as well as a lot of controversy avoided by working for the benefit of the whole in connection with the matter of interchange of cars. That is facilitated by government control which has permitted the consolidation of interchange inspection.

OTHER BUSINESS

On motion of T. J. O'Donnell (Buffalo), a telegram was sent to Director General Hines conveying to him the full support of the association.

J. R. Mitchell (W. H. Miner) suggested that since the association is made up of car foremen as well as interchange inspectors, the organization should take up car subjects in addition to the discussion of the rules of interchange. W. G. Wallace called attention to the fact that the International Railway General Foreman's Association at the 1919 convention changed the constitution and by-laws to make car foremen eligible for membership. This action was taken because the members felt the need of educating the general foremen in car department matters as this knowledge would be essential if they were promoted to the position of master mechanic where they would have charge of both departments. He urged the association to broaden its activities in order to stimulate interest and secure recognition from the higher mechanical officers.

Arrangements were made with the Simmons-Boardman Publishing Company to publish the convention report in the *Railway Mechanical Engineer* and the membership dues were increased to include subscription for the perodical.

On Wednesday a special train was provided for the members in order that they might make an inspection trip around the St. Louis Terminal District.

At the closing session L. T. Canfield of the Union Draft Gear Company delivered an address in which he emphasized the importance of the work done by the association and called attention to the opportunity the members had for noting the defects which developed in cars after they had been placed in service and for recommending improvements in the design.

Invitations were received from several cities asking that these places be considered when deciding on the location for the next meeting. Among the places suggested were Niagara Falls, Ont.; Buffalo, N. Y.; Saratoga Springs, N. Y.; Asbury Park, N. J.; Cleveland, Ohio; Detroit, Mich.; Harrisburg, Pa.; New York City and San Francisco, Cal.

ELECTION OF OFFICERS

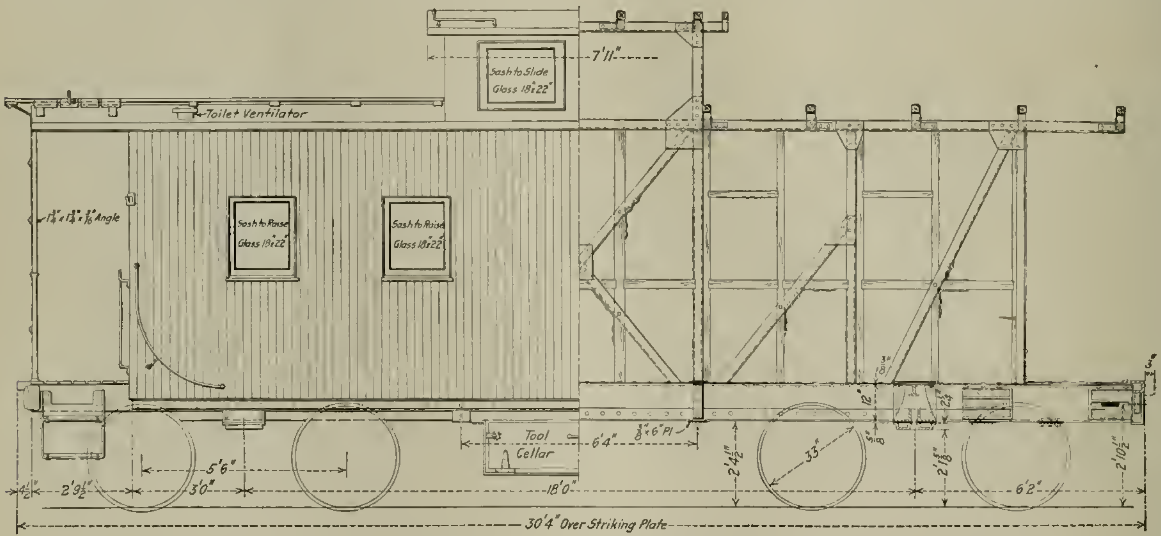
The following officers were elected for the year 1919-1920: President, J. J. Gainey, general foreman, car department, Southern; first vice-president, E. Pendleton, car foreman, Chicago & Alton; second vice-president, A. Armstrong, chief interchange inspector, Atlanta, Ga.; secretary-treasurer, J. C. Keene, chief car inspector, Wabash. Members of executive committee, W. J. Stoll, Toledo, chairman; H. J. Smith (D. L. & W.); W. P. Elliott (T. R. R. A. of St. L.); J. E. Gordon (N. Y. C.); C. M. Hitch (B. & O.); E. H. Mattingley (B. & O.); E. H. Hall (C. G. W.) and Charles Adams (N. Y. C.)

Cars and Locomotives in Russia.—The Ironmonger states that at the declaration of war Russia possessed in the neighborhood of 30,000 locomotives and 570,000 cars and that at the time of the revolution there were 6,200 locomotives and 120,000 cars in good condition, with 3,600 locomotives and 145,000 cars needing repairs. This has been considerably reduced and this year a new commission of the Russian government does not record more than 4,000 locomotives and 95,000 cars.

U. S. R. A. Standard Caboose Car

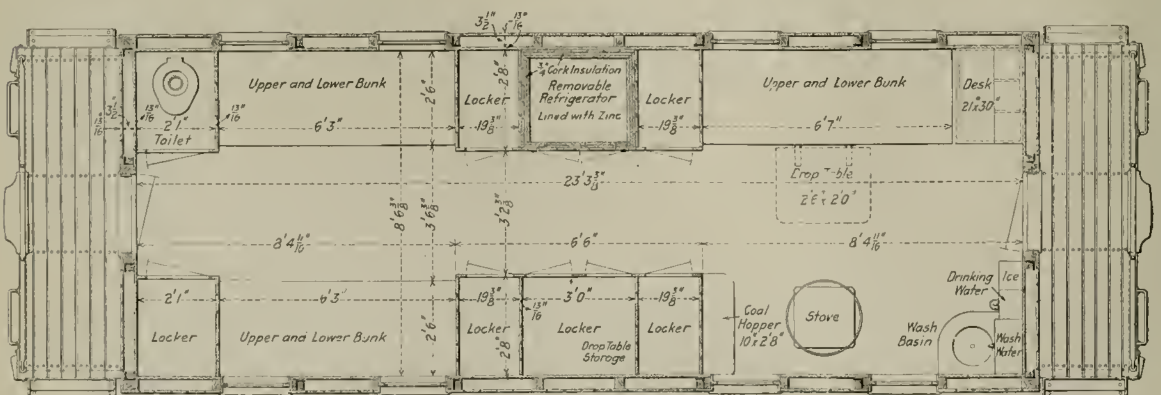
Design Recommended by the Railroad Administration; Strong Underframe for Heavy Pusher Service

The requirements of the laws of the various states in this country regarding railway caboose cars make it very desirable that a standard design be adopted for the construction of this class of car. To meet this need the United States Railroad Administration has issued an approved standard design for such cars. It is not proposed to require that cars must be built to these drawings, but to



Side Elevation of U. S. R. A. Standard Caboose Car

provide a design that, if conformed to by the railroads in building new caboose equipment, will insure the gradual elimination of cabooses of weak construction or faulty design. The proposed design is a 24-ft. caboose of the composite type, having a steel underframe and superstructure, with wood outside sheathing and interior finish.



Floor Plan of Proposed U. S. R. A. Standard Caboose Car

This design supersedes the original designs which provided for an all-steel caboose and a composite type. The first plan called for a caboose 25 ft. long but was only a preliminary draft and was never approved for the use of the railroads. This article shows the 24 ft. caboose recommended by the Railroad Administration for the future construction of cars of this class.

The Superstructure

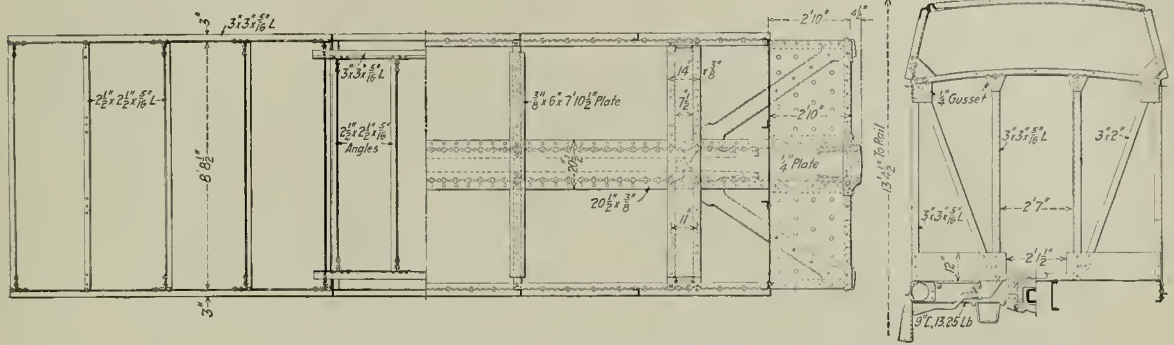
The body framing is built up of 3-in. by 3-in. by 5/16-in. angles, the side and end posts being adequately braced by angles of the same size and with gussets of ¼-in. steel plate securely riveted at the side sills and top plates and at intermediate points on the side posts.

The carlines are of the composite type with 2½-in. by 2½-in. by 5/16-in. angles, formed to a 24-ft. radius and secured by rivets to the side top plates. The cupola frame is constructed of 3-in. by 3-in. by 5/16-in. angles with the same type of carline that is used on the main body framing. The roof may be a canvas or plastic covering over roof boards secured to the carlines. Wooden filler posts and plates are secured to the angle iron frame and to these the 13/16-in. inside and outside sheathing is secured.

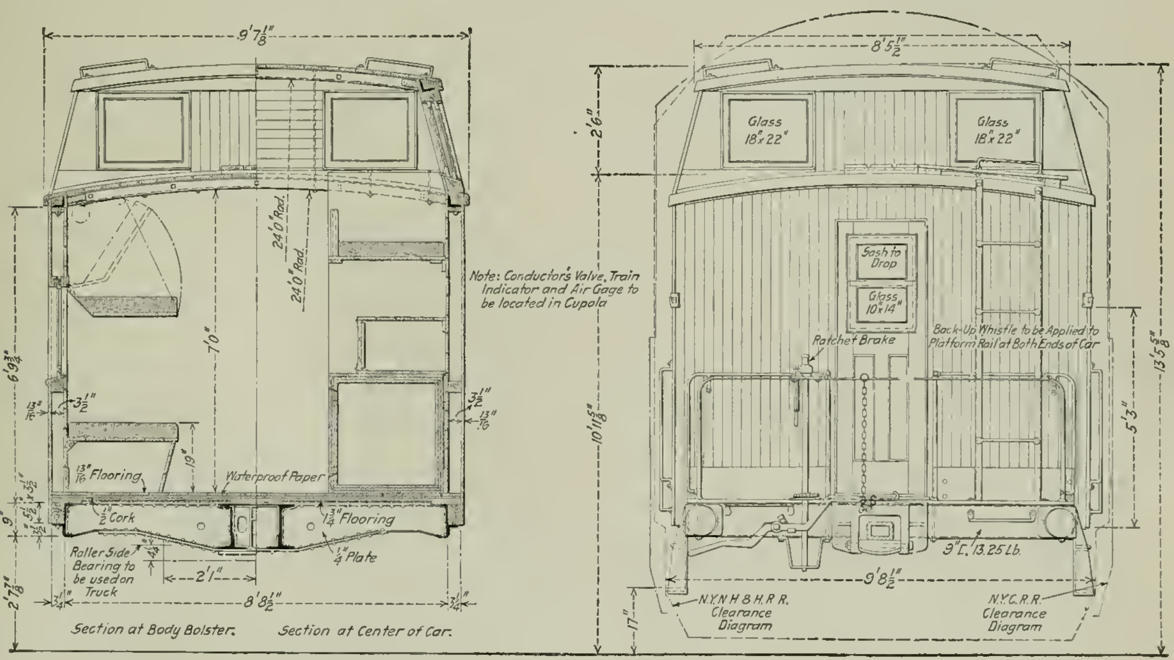
THE INTERIOR

The floor space is 23 ft. 3⅜ in. by 8 ft. 6⅜ in. inside of the sheathing, with a clear space of 3 ft. 2⅜ in. at the closest point in the aisle between the interior fittings. Two upper and two lower bunks, 6 ft. 3 in. by 2 ft. 6 in., and one upper and one lower bunk, 6 ft. 7 in. by 2 ft. 6 in. are conveniently located. The upper bunks fold upward against the carlines, giving ample headroom above the fixed lower bunks, which can be used as seats when not in use for sleeping purposes. The conductor's valve, train indicator and air gage are located in the cupola and seats are provided in each side of the cupola for observation purposes. The headroom in the main body of the car is 7 ft. and in the cupola 9 ft. 2 in. A desk is provided for clerical purposes, being so located that one end of a lower bunk serves as a seat. The tank for wash water, the wash basin and a drinking water tank are conveniently arranged in one corner of the caboose. A refrigerator, numerous lockers and drop tables, a toilet, a coal stove for heating the car, make up the complete equipment.

There are four windows, which may be raised, having 18-in. by 22-in. glass, in each side of the car, a window having a glass area of 10 in. by 28 in., with an upper drop sash, in the door at each end, and four windows with sliding sash having glass 18 in. by 22 in. in the cupola. The floor consists of 1¾-in. rough flooring, a half-inch layer of cork covered with a waterproof paper, and a 13/16-in. top flooring. A platform of ample width, formed of ¼-in. steel plate with wooden cleats laid crosswise of the car, is provided at each end. The roof canopies over the platform, thus giving some protection from the weather. Hand holds, ladders and steps are placed in the most convenient locations. A ratchet hand brake is applied and provision made for the application of a back-up signal whistle at both ends of the car. The uncoupling apparatus is connected by a



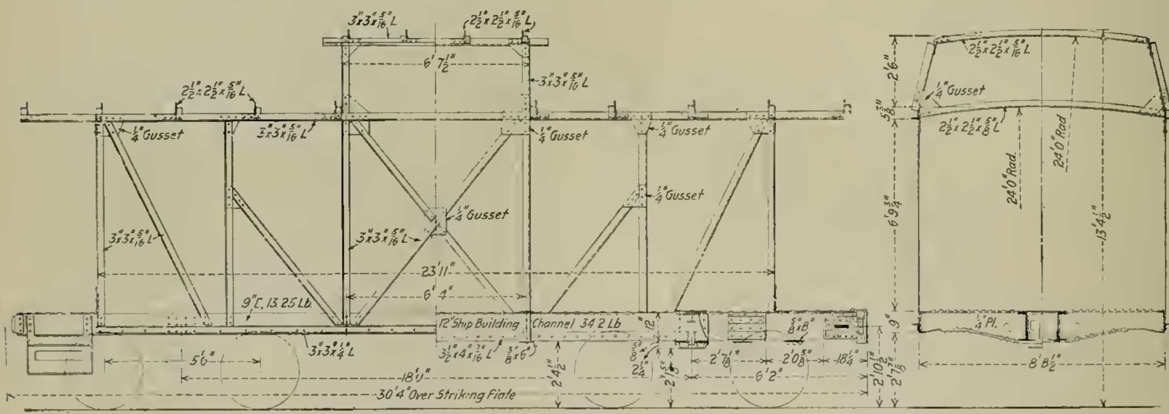
Plan of Underframe and Plan and End View of Body Framing of U. S. R. A. Standard Caboose Car



Cross Sections and End Elevation of U. S. R. A. Standard Caboose Car chain to the platform rail so that the car may be uncoupled without leaving the platform.

THE UNDERFRAME

In order to withstand the severe service in which many cabooses are used, where there are heavy grades and pusher service is required, the underframe is of unusually strong construction. The center sill is built up of 12-in., 34 2-lb. shipbuilding channel with a 3½-in. by 4-in. by 7/16-in. angle riveted to the bottom inside edge of the channel for the entire length of the sill. The top cover plate is of ⅜-in. steel plate 20½ in. wide. The side sills and end sills are made of 9-in., 13.25-lb. channel section, the side sills being reinforced on the outside with a 3-in. by 3-in. by ¼-in angle, which also serves as a support for the side nailing strips. The body bolster diaphragms are formed of ¼-in. pressed steel plate with a 3-in. flange. The top bolster cover plate is of ⅜-in. and the bottom cover plate of ⅝-in. steel plate, both 14 in. wide. The two intermediate cross-bearers are of ¼-in. pressed steel plate with a ⅜-in. steel top and bottom cover plate 6 in. wide. Diagonal braces at each end give additional rigidity to the underframe, and it should meet the requirements of the most severe service. The draft sills are designed to permit the application of any of the standard draft gears. A tool cellar of ample size is secured to the underframe.



Side Elevation and Cross Section of Steel Frame for U. S. R. A. Standard Caboose Car

THE TRUCK

The car trucks recommended by the Railroad Administration are of the four-wheel type with cast steel bolsters and side frames, and have a 5-ft. 6-in. wheel base. The wheels are to be 33 in. in diameter, mounted on axles having a 4¼-in. by 8-in. M. C. B. journal.

General Data

Length over striking plate	30 ft. 4 in.
Length over end framing	24 ft. 0 in.
Width over body framing	9 ft. 2½ in.
Width over side sills	8 ft. 8½ in.
Height from rail to top of main roof	11 ft. 1 in.
Height from rail to top of cupola roof	13 ft. 4½ in.
Diameter of truck wheels	33 in.
Wheel base	5 ft. 6 in.
Distance center to center of trucks	18 ft. 0 in.

This design is made to conform to the laws of all of the states except those of Missouri, which differ radically from those of the other states. It is intended to prevent the agitation of railway employees for state laws which, if adopted, might make it impossible in such states to use cabooses that are lawful in other states, and would result in the poorest cabooses collecting in those states having no stringent laws on the subject.

No attempt has been made by the Railroad Administration to specify all of the details of construction, but only to provide a general design for common use by the various railroads.

SUGGESTIONS FOR IMPROVING DRAFT GEAR MAINTENANCE*

BY L. T. CANFIELD

At the present time very few people are giving the question of draft gear maintenance serious thought, and the cost of car maintenance, damaged lading and loss of service due to bad order cars, leads me to make a few suggestions.

First. The car inspectors should be carefully instructed on the question of draft gear inspection and its importance to economical operation. I realize that for a while it will be necessary to continue to let some gears run for a while longer, but each repair track should take all it can handle.

Second. Each repair track where a large number of cars are repaired should have as a part of its organization a crew of men in charge of a competent foreman, to repair draft gear, specializing on this just as the air brakes are handled. The foreman should be familiar with all makes of draft gear. In a short time this would result in a reduction in the number of bad order cars as well as in the maintenance cost.

Third. There should be rules making it compulsory to take the draft gear down and make needed repairs at the expiration of three years. Should a car be on a foreign line with draft gears that have had more than three years' service without repairs, the road having the car should make the repairs. The time between repairs may be lengthened if found too short. This would not be a big task. Reduced to the number of cars per day it is only 2,777 cars for the entire country. I would not be surprised if there are not more than 2,777 repair tracks. If so, it would be only one car per day per repair track. There is no rule in effect now, the gears are allowed to run as long as they are not broken or pulled out, or some more expensive part of the car or lading is injured because of the neglect to the draft gear.

The practice of using old draft gear springs in repairs to cars should be watched very closely. If they have taken any permanent set they should be discarded and new ones used. This is not an extravagant suggestion, as the saving of $3.30, the approximate cost of a new spring, may take a couple of inches work (as represented by the drop hammer) out of the draft gear and result in breaking a coupler which would cost $25 to $30, or turn over a piano inside the car, at even greater cost.

*From a paper presented at the General Car Foremen's Association of St. Louis.

Maintenance of Freight Equipment*

Economy of Retiring Old Cars; Better Repair Facilities and Greater Interchangeability Desirable

By L. K. SILLCOX

THE economic situation with respect to the performance of that great vehicle of commerce, the freight car, is one of basic importance. Any success in railroad operation corresponds largely to the net number of car miles attained per car per day, which figure ought to be as nearly 40 or above as possible. Why many roads are only showing 30 or even less miles is probably due to many causes beyond the exact knowledge of the writer, but in any event, so far as the problem is affected from the standpoint of design, maintenance and inspection of freight car equipment, a number of conditions deserve calm analysis.

WEAK DRAFT MEMBERS MOST SERIOUS DEFECT

One noteworthy fact, the explanation of which I have tried to investigate, should be first mentioned. Of all the complaints which are general in the operation of freight train equipment at the present time, the behavior of the weakly constructed design of car is found to be the most perplexing, principally due to draft attachment failures in combination with dangerously inadequate running gear members, such as truck, side frames, axles and bolsters. Although this difficulty is in greater measure due to wooden underframe cars, yet it is also noticeable in the case of improperly designed steel cars. Right at the present time, there is a tremendous demand for suitable cars, which is not being satisfied and yet, it would appear to any thoughtful man that too many cars are standing idle which ought to be making their just proportion of revenue mileage. It does not seem to be altogether a case as to shortage of cars, but rather a matter of having more cars made really fit.

It has been said that a very large percentage of cars should be destroyed, especially those of wooden construction. A careful check, extending over a period of seven months in normal heavy trunk line service, has demonstrated that we can expect about 20 per cent or 30 per cent of the house cars used at this time to be of the type which we generally term as weakly constructed not being as yet reinforced with metal draft attachments or ends. The problem to be determined in a decision concerning the retirement or reconstruction of any such car is generally influenced by the distinctive demand for the equipment on the owner's line and a knowledge of whether the expense of betterment or improvement to the existing equipment is offset by the capitalized value of the saving which can be realized in the maintenance account, as well as keeping in mind the better characteristic operation which is practically guarranteed from such a program. Extended observation has often brought out the fact that the capitalized saving in the repair account through the adoption of an intensive retirement program and the acquisition of new high capacity units in equal number or tonnage which are bound to present very much greater service capacity and earning power, if there is a paying demand for tonnage space, has proven most practical. It will never be found possible satisfactorily to determine upon any general policy without a most careful unit study for each class of car, besides being fortified with a liberal knowledge of the exact operating possibilities of the property owning the equipment.

REPAIRS ON FOREIGN LINES MUST BE CONSIDERED

Another serious limitation to our field of selection in the matter of deciding between reinforcement or retirement, and subsequent replacement in satisfactory designs, is the fact that the majority of defects occurring in connection with car equipment when off home lines, except in case of derailment or fire, have only in late years been made owner's responsibility. This is where a vast amount of money is apt to be applied beyond the control of the car owner and will undoubtedly bring about, of its own accord, more systematic analysis in the future as to deficiencies in each class of car in order to guard against the possibility of duplicating repairs to failed members which do not meet present day requirements; so that the sum total of expense for any class of rolling stock does not become excessive, due to a large part of the work being repeated so continuously and carried out beyond the immediate observation of the car owner, resulting in extravagance, though not necessarily for the total equipment owned. Of course, under these circumstances excessive maintenance charges will not often be so easily reflected in system statements covering total ownership, as in grouped classes, which it is desired to observe.

ATTENTION BEFORE LOADING PREVENTS DELAYS

It is especially urgent that the best interests of the shippers and dealers, as well as of the railroads which serve them, be maintained by the inauguration of substantial repair practices which will insure a minimum delay of cars on shop tracks and lines of roads chargeable to their general condition and style of construction. Thorough inspection and repairs of cars before loading and careful attention to brakes, lubrication, running gear and lading after classification at originating terminals are a fundamental necessity. Cars set off on the line of road due to bad order condition of couplers, draft rigging, wheels, brakes, heated bearings, shifted lading and other similar causes are usually the outcome from lack of proper attention at the originating terminal, which results in accidents, destroyed lading and cars, reduced train rating, delays to traffic, blocking of passing tracks, engine and train crew overtime and extraordinary expense for sending men and materials out on the line to eventually make repairs.

WEAK CARS SHOULD BE KEPT ON OWNER'S LINES

As already referred to, it is a fact that at the present time nearly all systems are offering in interchange some loaded and empty cars that are of such design or condition as to make them entirely unfit for the service to be performed on the average trunk line railroad. This class of equipment, which cannot be depended upon to pass properly in main line movements, should be restricted to owner's lines, where it can haul the maximum amount of commercial and company lading with the least liability for delays, transfer or repairs. When a freight car of undesirable class and capacity has outlived its usefulness from the standpoint of commercial utility, age, decay, corrosion, obsolescence or accident, so that the expenditure necessary to put it in serviceable condition is not justified, it should be dismantled forthwith. The intensive movement of tonnage, creating an acute demand for power and a severe congestion in terminals, has at many points made it impractical, due to the time consumed and necessary switching required, to place weakly constructed cars in the rear of long trains. That is why this subject looms so prominently before us today. Tremendous damage is done to these weak cars and especially when not protected against the hammer blows of

*From a paper presented before the Western Railway Club.

modern operation. Not only this, but delays and accidents result from this condition.

REPAIR FACILITIES ARE INADEQUATE

Freight car repair yards have been located at inconvenient out of the way places; repair tracks have been set too closely together for convenience: the facilities for repairing have not been the best, and the consequence has been that cars which should have been returned to service promptly and with repairs properly made have been held out of service longer than necessary and were not properly repaired. Never before has there been such pressing necessity for intelligent work, for proper tool equipment and for shelter for the men employed as at the present time. It is a reflection on good judgment when cars are held out of service for which there is a paying demand at the time, and it would appear that with the attention now concentrated on the railroads, best efforts are not only desirable, but absolutely necessary for a relief of the conditions.

The scope of the operations in commercial value; the great numbers of men coming under the control of the mechanical department; the drift of the times concerning methods for carrying out the work and the very intensive service necessary to transportation matters, as well as the growing importance of economies, all tend to make us focus our attention on these questions. There is no denying the fact that all these matters involve, more than any one thing, the element of men, and if we are going to best the best from our men, we must provide responsible supervision with necessary support and initiative so as to maintain action and make good from day-to-day. The moral responsibility of everyone is as great and as constant whether one is here or there, or doing one thing or another, and this responsibility is in exact proportion to the intelligence of the individual coupled with whatever measure of freedom for action is allowed. It implies leadership and teaching, not in some things to be sure, but in all of the relations that bring individuals together in industry and business, so that our choice, especially among our highest supervisors, should be along most practical and fundamental lines. This is only referred to as a timely suggestion, since it has so far reaching an effect that words fail to emphasize its importance.

GREATER INTERCHANGEABILITY DESIRABLE

The first division of the subject assigned to me has regard for the design of rolling stock. I do not think it is reasonable to believe that the roads will adopt and maintain one standard type of car indefinitely to a single inflexible pattern. There are sure to be improvements and modifications, which different groups of railroad men think it desirable to make and such motive would be difficult to subdue. It would seem proper for the draft lugs, truck frames, truck bolsters, center plates, striking castings, coupler carriers, brake beams, truck springs, drawbar yokes, uncoupling mechanism, brake hangers, drawgear carriers and center plate height of truck to be standardized and made interchangeable to a greater degree than at present, both in new and repair work. It does seem indefensible, that the slight variations made in these parts should necessitate their being obtained from the car owners. In designing a car, what must be considered is the service in which its paying demand rests, not the service in which it may possibly run. It is only fair to assume that every railroad management aims to place into service cars built in a substantial manner. Standards in detail construction have been adopted by the Master Car Builders' Association which have assisted greatly in reducing the amount of stock necessary to be carried. The difficulty seems to be that these standards have not been enforced under mandatory rules and their full practical value has never been properly felt on this account. I believe the time has arrived to introduce additional standards affecting the maintenance of box cars which can also be applied to all types used in interstate service.

The application of steel center sills, as well as draft arms, to old cars will not only prolong their life, but cause them to have a more continuous earning capacity, due to not becoming marked out to shop tracks every few hundred miles for the application of draft timbers and end sills, as well as avoiding damage to adjacent equipment and delays to trains, and in terminals, to say nothing of the tremendous losses due to damaged lading and loss of patronage, where delays and slow delivery become epidemic.

POORLY DESIGNED CARS ARE A SOURCE OF TROUBLE

Mechanical and transportation officers have seen and appreciate the results of poor designing and inferior construction, both as regards wooden and steel cars. One of the surprising features with regard to many steel cars in service which cause the greatest trouble and embarrassment, is that they are not of particularly light construction, but the metal has been disposed with very little regard to the engineering feature of service requirements actually encountered. There is no doubt whatsoever but that many of these cars could be built with at least equal or even lass weight than originally set aside and a perfectly satisfactory structure obtained. This is what is so confusing to the minds of executive officers, when they have purchased and placed into service, not a cheap or even a light car and it fails, then on top of it all, it is necessary later to recommend reconstruction and additional expense in order to stop permanently, a severe leak in the maintenance account. New fads in the design and building of car equipment should not be permitted, or any innovations, until thoroughly tried out and known to be reasonable and capable of standing up in normal heavy service for at least a period of five years, besides being passed upon by uninterested, competent authorities.

It is not alone the larger locomotives being used today which have called for a more thorough investigation of the subject of car design and construction, but also the severe shocks which cars are receiving in classification yards. The superstructure of box cars should receive just as much attention as the underframe and trucks, otherwise, leakage and subsequent loss of metal roof sheets through racking and frames not being kept in alinement is bound to result, and when this happens, it places restrictions on the ultimate utility of the car for service where leakage is harmful.

WOODEN FRAMED CARS NEED STEEL CENTERSILLS

In discussing any problem dealing with the continuance in service of the all-wood car, as compared to an intensive program of replacement in the all-steel and steel underframe classes, the strongest argument in favor of the general adoption of the latter, and one which is barely, if ever, touched upon, is the fact that wooden framed cars are always damaged when in collision with steel underframe cars, while the latter escape uninjured. If, because of their decided economy, the more recent designs of metal construction are continued in use, then it is essential that other cars associated with them should be made strong enough to withstand the severe shocks incident to the movement of heavy tonnage trains now so generally experienced. There is no doubt that the light wooden cars may be strong enough to carry the load for which they were designed, but they need a stiff backbone in the underframe to protect them from being crushed in the middle of a long train or between two heavy cars under impact. The same argument of uniformity holds true of couplers, draft gear and brake equipment. It is for this reason that we must at this time give more positive backing to the need of metal reinforcement programs for cars of light design, rather than hesitating on a questionable economy in operating expense, due to carrying larger loads and less dead weight. It simply must carrying larger loads and less dead weight. It is a question of modernizing cars or retiring them from service.

WOODEN VERSUS STEEL CARS

With respect to the life of the wooden car, compared with steel, it is well to state that none of the modern steel cars have been in use long enough in general operation to determine their ultimate length of useful service. It has been found, however, what may be expected of all metal coal and other special classes of cars on prescribed lines, having a given commodity and territory; this, of course, is of valuable comparative local use only. There is great difference of opinion about the loss of weight in steel due to corrosion and this may well be expected due to varying climatic conditions experienced, and until some definite conclusions can be drawn, based on a wide range of observation under every service condition, any data used must be employed with caution. Records indicate foundation for the opinion that wooden cars have been in continuous use from 20 to 30 years, but it is probable that such cars have been rebuilt from the sills up once or even more times in that period, so that we ought not to be disposed to question the assumption of the average life of such cars being 20 years. With respect to the high cost of repairs to wooden, as compared to steel equipment referred to, and which is almost always carried on gradually, we must not forget that for steel cars, up until the time rebuilding is necessary, usually only light repairs are carried out, due to the various roads not being equipped to do the heavy work at this time. Therefore, any comparative costs should be viewed with these thoughts in mind and wrong conclusions avoided.

INCREASE IN COST OF FREIGHT CAR REPAIRS

Such a large proportion of failures in units of freight car equipment, as is now being experienced, appears to indicate that there is something radically defective in the elementary handling of the transportation problem or else the maintenance features have been neglected and not kept in stop with the advance movement of the service to be rendered. The cost of freight car repairs has been continually increasing and in somewhat greater proportion than the advance in labor and material accounts would explain. The tendency for such increases can only be offset by providing all means that aim to reduce the number employed and get the greatest possible output from each man. This not only makes itself felt upon the payrolls, but reduces the time cars are held out of service, which is another source of revenue. In dealing with concrete cases showing the increase in freight car repair costs, a table is shown below for eight of the largest Western railroads.

Road	Year	No. of freight equipment cars	Average miles per freight car per year	Cost of freight car repairs per car per year	Cost of freight car repairs per mile—cents
A	1916	66,409	11,593	$69.13	0.599
	1917	70,396	11,853	68.12	0.558
	1918	70,400	12,064	146.52	1.221
B	1916	57,401	8,931	53.98	0.60
	1917	58,256	8,396	66.64	0.80
	1918	55,819	8,987	147.13	1.64
C	1916	47,985	10,974	58.76	0.54
	1917	47,845	11,171	74.98	0.67
	1918	50,079	10,376	133.60	1.29
D	1916	46,925	11,098	85.59	0.80
	1917	46,281	11,191	126.92	1.13
	1918	45,993	10,459	201.23	1.92
E	1916	68,339	13,059	74.66	0.57
	1917	67,828	14,553	88.46	0.61
	1918	69,622	11,145	149.88	1.35
F	1916	67,370	13,053	98.16	0.75
	1917	67,168	11,214	122.93	1.09
	1918	61,457	11,905	266.57	2.24
G	1916	63,143	11,646	120.20	1.03
	1917	64,919	12,377	113.12	0.91
	1918	66,741	12,810	177.18	1.38
H	1916	81,034	9,468	71.48	0.76
	1917	83,147	9,499	84.84	0.89
	1918	72,141	9,377	146.36	1.58

The serious increases in total expense from year to year are attributed more to the character of equipment owned than any other feature and the logical proposal is, therefore, that more rapid retirement of obsolete equipment should be carried out. When such cars are dismantled and permanently removed from service, one of the features which can be expected to effect a saving and prevent such increases as indicated above is the relative reduction in the amount of material used for repairs to old cars. It can be fairly well stated that the total car repair expense is about equally divided between labor and material, under normal conditions where extensive reclamation operations are resorted to locally, thus holding down the amount of new material obtained to a minimum. Most wooden cars are at least 15 years old and many have seen 25 or more years service. Comparatively few of the weakly designed cars complained of have been reinforced with metal draft rigging. Failure of draft attachments and associated parts contribute to the serious increase in cost of repairs.

LIMIT FOR REPAIRS DOES NOT FORCE RETIREMENT OF CARS

It seems to be a general practice to place small limits of expense on these older cars with the idea in mind that these limits would force such cars to be automatically taken out of service as they become deteriorated beyond a point where repairs would be economical. It can be shown tbat this equipment is on the repair track a large portion of the time, and in each instance just sufficient work is done to run the car a little further owing to the policy of concentrating on light repair work first where a demand for equipment exists. Such a plan of retirement does not work satisfactorily and in the end the roads have far exceeded any proposed sum of money which they planned on placing against these old cars to keep them in service. I do not think anyone who has followed the plan in question has ever found the result in practice any different than stated.

LOW STRESSES PROLONG LIFE OF PARTS

During winter months, and at times of heavy tonnage movement, wrecks and delays caused through breaking down of trucks are very serious matters and the question is always asked as to why such things happen. Fatigue failure in metal truck frames, axles, bolsters and other portions of equipment is characterized by suddenness, and oftentimes occurs immediately after careful inspection has been made. The fractures sometimes disclose a crystalline appearance over part of the surface and it is this feature which has many times given rise to the term crystallized. This supposition, however, has been found generally false, since close examination of metals under stress show no change of the general scheme of internal structure, but under severely heavy stress there appears a gradual breakdown of the crystals forming the member. Metal used for the running gear of cars is more or less ductile, and when these parts are deformed cold, the first yielding occurs in the particular grains which either take the most stress or have the lowest elastic limit. The failure in such metals subjected to repeated stress takes place with substantially no general deformation, but there is, however, considerable localized distress among the structural particles, which increases directly with the number of applications of stress. Car trucks have imposed upon them repeated stress in service and failure seems to develop in proportion to the continuous mileage made. In analyzing specific cases of breakages, they seem to appear almost exclusively through the unification of yielding particles, with the result that cracks develop with final added stress, promoting the extension of this crack into the adjacent area on both sides. Steel must be considered as filled with a multitude of minute flaws, originating at the time the metal becomes solidified. In static testing, steel under stress of about one-half its ultimate strength passes into a semi-plastic condition, in which there is a gradual flow of the material. Under such condition, the small flaws have almost no effect upon the flow or upon the static strength. When steel is loaded to moderate stresses, the yield is almost entirely elastic in general, but a small portion of its inelastic energy being taken up by the steel itself. In this way it can be reasoned that sufficient material is necessary to any truck side frame or bolster in order to keep down the working load of the material and give long life to the part. Of course, where springs are improperly designed to carry the load, truck members receive hammer blows in service for which they were never designed and this seems to be particularly true in the case of the M. C. B. grouping of springs for 50 ton cars as often they stand practically solid under the static weight of the car and lading. This is a subject which should be placed before the proper committee of the M. C. B. Association.

As a plan of interesting local foremen in the discharge of their duties, it is well for them to have a working knowledge of the money they are spending and a form has been adopted which is filled out daily by the foremen and is wired to the general offices twice a month. Very interesting results have been obtained from this practice and establishes the plan of foremen going over time slips personally to know that labor charges are being properly distributed. With this data, and knowing the amount of work turned out, a good practical analysis is obtained concerning relative efficiency month by month which guards against excess overtime payments and similar wastes.

FREIGHT TRAIN INSPECTION

Before closing this paper, I will only refer briefly to the question of freight train inspection. On the road with which I am connected practices have been adopted which have done a very great deal to couple and unify our efforts, especially in through business, besides positively maintaining the responsibility of each individual engaged and avoiding as much as possible any duplication of inspection.

The desire to save time and cost of inspection by resorting to the so-called safety inspection of some roads has about reached its limit. The class of men that railroads are obliged to draw from, in some districts at least, do not make the most expert inspectors. The saving in reducing the number of men and time to make the usual superficial safety inspection oftentimes proves a serious less, for the result of a derailment or wreck on account of a loose or defective wheel or some other important part of the running gear or brakes which have been overlooked on account of time or judgment, is worthy of serious consideration. No one will deny that all cars are rankly abused, but very little is heard of crews being suspended or even censured on account of damage to rolling stock, no matter what the extent. The ultimate loss cannot be measured by figuring the cost of renewing certain broken parts when cars are abused for premature failure of other parts will follow.

Consideration of overtime and the sixteen hour law, as well as expeditious train movement, demands the minimum lapse of time between that for which the crew is called and that when the train departs. Hence, a train prepared for departure should require no more brake work after the engine is coupled than, at the most, stopping a few leaks in hose couplings and making the formal test. But often today there are greater delays due to making other repairs, or the train proceeds with less efficient brakes than required.

To avoid this, the repairs required must be determined with arriving trains. The incoming engineer should add to the reduction required for stopping enough to fully apply the brakes, and the brakeman should await his advice that this has been done before cutting off the engine. Car inspectors should be present to make an immediate examination and to bad order all defective brakes. Such repairs as ordinary brake pipe leaks, defective hose and wrong piston travel, should next be made, but cars requiring heavy brake repairs be marked for the repair tracks.

In this matter, judgment must be exercised as perishable or other very important loads as well as empties needed at once for such lading, must not be delayed. Neither should other less important cars be held in numbers far greater than the local force can repair in a day if such force is as great as the regular amount of work, including such repairs, would keep busy. The car foreman and the yard master should consult to adjust the foregoing, but when the former removes bad order marks without repairs having been made, he should fill out and apply an air brake defect card to insure repairs at the earliest possible date.

DISCUSSION

G. S. Goodwin (C. R. I. & P. Ry.) stated that at the present time the railroads were justified in making more extensive alterations when reinforceing old cars. He cited the fact that steel frame box cars which formerly could be purchased for $900 now cost $3,000.

T. H. Goodnow (C. & N. W.) expressed the opinion that the retirement of wooden cars is one of the most important problems confronting the mechanical department at the present time. There are still in service a great many wooden cars of 80,000 lb. capacity built between 1902 and 1907 which have as high cubical capacity as cars being built, at the present time. These cars will give good service if reinforced and the work should be done without delay. Mr. Goodnow called attention to the many circumstances which must be considered in analyzing statistics regarding freight cars. He doubted whether any reliable figures showing the relative life and cost of wooden and steel cars were available because the early all steel cars were confined almost exclusively to gondola and hopper types which cost less to maintain than house cars. He called attention to the large percentage of foreign cars which all the railroads had on their lines during 1918 and stated that for this reason the expenditures for freight car repairs did not furnish a true indication of the relative cost of maintenance of the equipment of the various companies. He said the past two years had proved that cars cannot be taken care of as well away from home as when the equipment occasionally reaches the owning road and favored greater standardization of truck and draft gear parts to facilitate maintenance. He indorsed the system of organization in force on the C. M. & St. P. and stated that an individual car department was necessary in order to get the best results from the local organization.

J. W. Luke (A. T. & S. F.) expressed the opinion that some roads are not keeping cars in such fit condition at the present time and the standard of equipment maintenance would not be improved unless the burden of repair work could be distributed among all the roads. From the year 1917 to 1919 the Santa Fe's expenditure for repairs to foreign cars rose from $1,690,000 to $7,700,000, an increase of 355 per cent. Mr. Luke advocated the reinforcement of wooden cars with steel channel center sills and stated that the cost of maintenance of cars so improved compared favorably with modern equipment.

C. Wymer (C. & E. I.) mentioned that sometimes the equipment is designed with no thought of future repairs and the replacement of minor parts necessitates expensive dismantling. Such construction inevitably increases the cost of repairs. In the course of the discussion Mr. Sillcox elaborated on some of the points brought out in the paper. To emphasize the necessity for retiring cars of wooden construction, he quoted statistics showing that 76 per cent of the cars damaged in service were cars with wooden underframes. The failures were distributed as follows: draft gear 63 per cent, knocked off center 14 per cent, end frame failure 14 per cent, cornered 9 per cent.

SHOP PRACTICE

SHOP PRACTICE AT TRANSCONA

BY S. LEWIS
General Foreman Blacksmith, Canadian National Railways

The bulldozer has contributed greatly toward the present high efficiency of the railway blacksmith shop, and can be used for a variety of work other than that for which it was originally designed.

When a die or tool is considered, the first thing to be decided is whether or not it can be made to pay, and if so, how much. The answer to this question often involves very many others, but can generally, if not always, be resolved into computations based on the number of pieces to be made, and the probable cost of labor per piece when made with and without a die, and also the cost of the die, including maintenance.

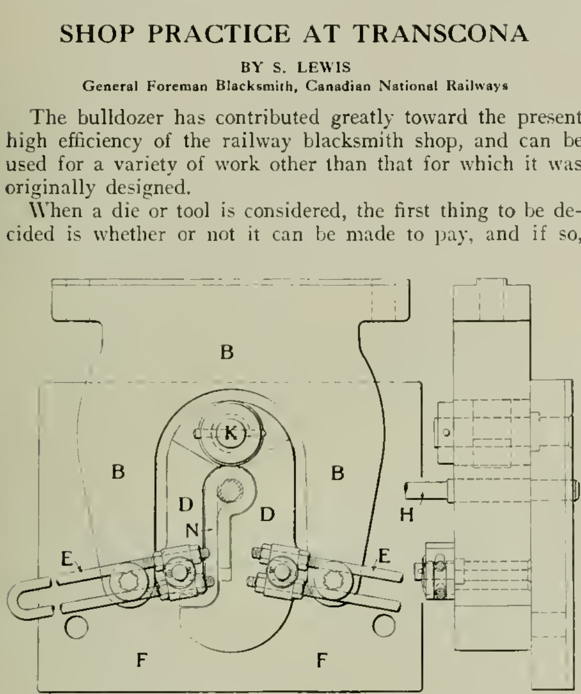


Fig. 1—Arrangement of Dies for Forming Hinge Butts

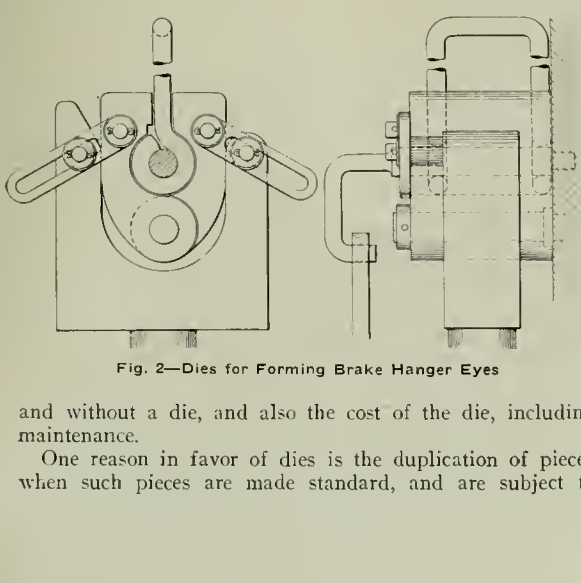


Fig. 2—Dies for Forming Brake Hanger Eyes

One reason in favor of dies is the duplication of pieces when such pieces are made standard, and are subject to great wear and tear. Another reason is accuracy, which can only be attained by the use of such dies. There are certain classes of work which could not be finished at all within the limits of uniformity and accuracy demanded if dies of some sort were not used.

Typical examples of dies which have been used successfully on this class of machine in the Transcona shops of the Canadian National Railways are shown in the illustrations.

Fig. 1 is a compound arrangement intended to form apron hinge butts for Hart cars, with which dies thousands of hinges were successfully formed in one operation. The moveable head *B* takes the form of a *U* shape; attached to the head are two adjustable links *EE*, which cause the two inner arms *DD* to swing open. These two arms are closed by the forward movement of the *U*-shaped head. The swing arms *DD* hinge around the pin *K*, which is fastened to the plate *F* and is bolted to the table of the machine.

The arms, when forming the hinge butt *N*, swing around the adjustable pin *H*, which can be pulled out, and with a few taps of the hand hammer the hinge falls off. All these parts are made from mild steel and very little machine work is necessary.

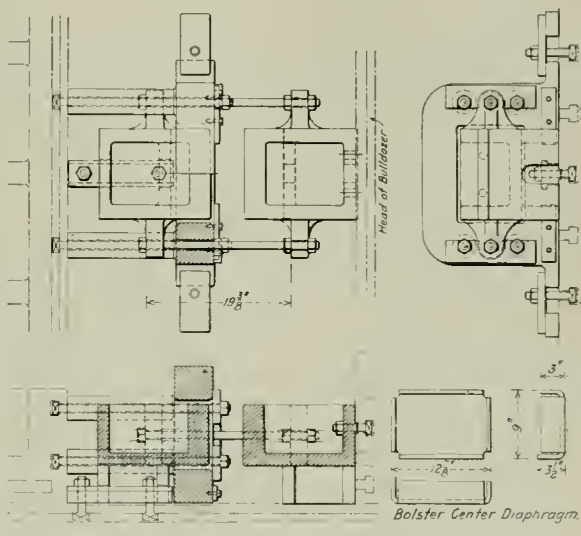


Fig. 3—Dies for Forming Bolster Diaphragms

The economy of this arrangement is obvious and all that is required to form a variety of hinges are the swing arms, several sizes of which can easily be adapted to the one arrangement.

In designing dies of this nature a great deal depends on the character of the work to be done. To insure an easy movement of members with a minimum strain and a maximum formation of parts to be produced, the dies should be made as light as is consistent. Care should always be taken when planning tools of this character so that the work may easily and accurately be located in order to prevent mistakes. This will add considerably to the efficiency of the operator.

Fig. 2 is an arrangement similar to Fig. 1. This arrangement is assembled on an air bulldozer and has served a great purpose in the pioneering days of the transcontinental road. Brake hangers are made on this machine in two heats and two operations. This die bends both eyes of the leases the pieces from the dies after forming them as shown in the illustration.

Fig. 4 is an example of a simple drill jig used at the Transcona shop to drill holes in coupler pins. A cover of the simplest design contains the guide bushings, which are changeable to suit whatever drillings are required and can handle a variety of such work with great rapidity. The bushing holder can be raised or covered to suit different diameters of work. Both V blocks in which the work rests are adjustable, by means of the screws, for different lengths

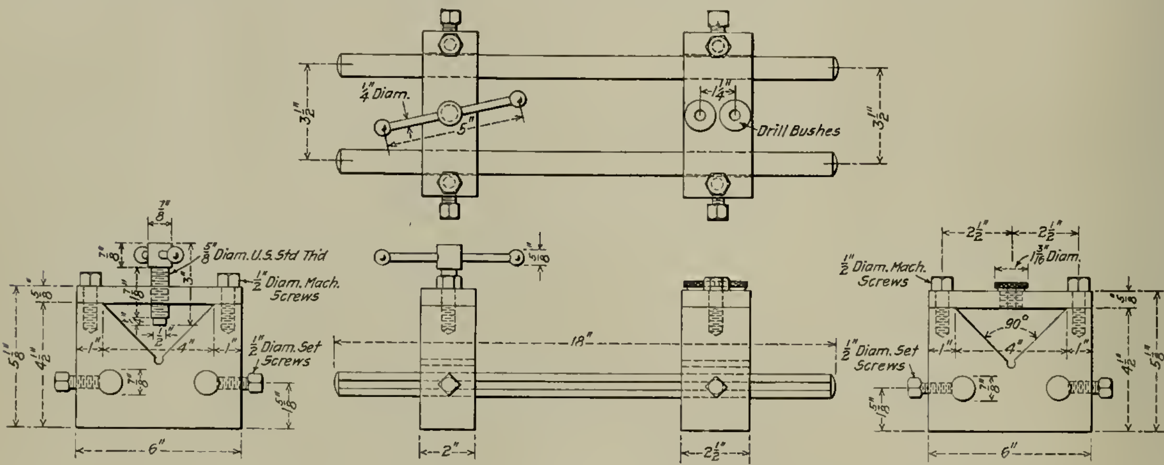


Fig. 4—Drilling Jig for Drilling Holes in Coupler Pins

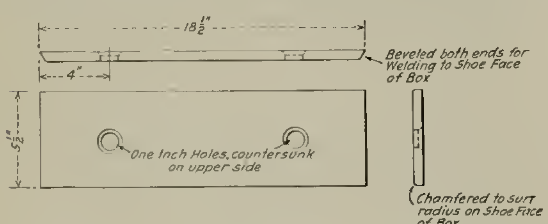
hanger simultaneously at one operation at a cost of 1½ cents.

A die to form a bolster center diaphragm is shown in Fig. 3, assembled on a 150-ton hydraulic bulldozer. The diaphragm plates are 4-in. by ½-in. by 1 ft. 5⅜-in. and are partly heated. The backward stroke of the machine re- of pins and lend themselves well to a variety of work of all descriptions. It also provides a clamping device, which is very essential to keep the work in position while being drilled. It is simple, efficient, and a characteristic example of an adjustable type of jig.

LINERS FOR DRIVING BOXES AND PEDESTAL CAPS

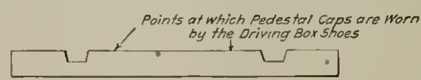
BY A. W. CONWAY

When the shoe faces of driving boxes have become worn below the standard limits by wear and repeated facings, it has been the usual practice to have dovetailed slots cut lengthwise in the shoe face and then pour them with bronze. An improved method of renewing the shoe face is to electrically weld on steel plate liners of suitable thickness to replace the amount the box is worn, making a more durable liner than the bronze. By making the liner of suitable thick-



Driving Box Liner

ness it need only by skinned off when planing it, thus reducing machine work to a minimum. When the bronze liners were used it was necessary to pour an excessive amount, as it was difficult to gage just the proper amount to pour, so there was usually an inch, more or less, to plane off. This new method saves the work of dovetailing to hold the bronze, the time necessary to melt and pour the bronze, and we have a bronze shoe wearing against a steel pedestal jaw on one side and against the steel box liner on the other side, which is far better than bronze against bronze. The holes are placed about four inches from the ends, as the



Pedestal Cap Re-Lined by Welding

only time when the liner is likely to tear away is during the planing.

It has also been common practice when pedestal caps are worn by the movement of the shoes, to true up the worn surface on a shaper, and then drill and tap the pedestal cap to secure on it a liner of a thickness that will make it flush with the unworn surface of the cap. This worn surface can be built up by the acetylene process and then hammered, making a very neat job, which is far superior to the older method of renewing the bearing surface.

CHECK LEAKS IN WELDING APPARATUS.—Never permit the slightest leak to go unchecked in a welding or cutting apparatus. An oxygen leak is expensive, and an acetylene leak is not only expensive but dangerous. Slight leaks in the hose or connections can be detected by shutting off the regulator valves and closing the cylinder valves, and noting how long the pressure holds up in the pressure gages. If the pressure falls, hunt for the leak.—*Autogenous Welding.*

Steel Treaters' Society Convenes

Modern Shop Practice and Equipment for Heat Treatment of Cutting Tools and Forgings Discussed

The American Steel Treaters' Society held its first convention at the Seventh Regiment Armory, Chicago, September 23-27. This organization which was formed in September, 1918, for the study and development of the art of heat treating steel, now has a large membership with chapters in nine cities. Many railroad men have become identified with the society and it is planned to give special attention to problems in which the railroads are interested. The convention was opened with addresses of welcome by H. H. Merrick, president of the Chicago Chamber of Commerce, and by the acting president of the society, T. E. Barker of the Miehle Printing Press & Manufacturing Company. At the later sessions a large number of subjects were discussed. Some of the papers are not available, but abstracts of two having direct application in railroad shop practice are given below and others will be published in future issues.

TYPES OF PYROMETERS AND THEIR USES

BY RICHARD P. BROWN
President, The Brown Instrument Company, Philadelphia, Pa.

Greater progress has been made during the past ten years in the use of pyrometers than was made in the 200 preceding years during which pyrometers were known and used to some small extent. The old methods of measuring temperature by the expansion or fusing points of clay, by the expansion or contraction of metals, and by numerous other means, have largely been eliminated today and there are practically only two methods of measuring high temperatures. The thermo-electric pyrometer embraces either a thermo-couple inserted directly in the heat, or in the form of a radiation pyrometer with the thermo-couple heated by the furnace rays; second, the optical pyrometer, in which a color comparison of an incandescent body and the steel under treatment is made. The optical pyrometer is used only portably, as this instrument is not suitable for permanent installation or for automatically recording temperature. It is used quite extensively where it is necessary to focus on a particular piece of steel in a furnace to secure its temperature, or where excessively high temperatures are measured, around 3,000 deg. F. or 1,600 deg. C., where a thermo-electric pyrometer is not suitable.

THERMO-ELECTRIC PYROMETERS

A thermo-electric pyrometer consists of a thermo-couple, a measuring instrument, and the leads connecting the thermo-couple and the meter. The thermo-couple is formed of two dissimilar metals, usually drawn into wire and with one pair of ends twisted together. When this junction is heated, it generates a small current of electricity which can be measured on a milli-voltmeter.

A thermo-couple produces current, dependent on the temperature of the twisted junction extending into the furnace, known as the hot end, and the opposite end outside the furnace, known as the cold end or cold junction. It is at these ends that the leads running to the meter are joined to the thermo-couple. In accurately measuring temperature with a thermo-couple it is, therefore, essential that the cold junction be maintained at a known fixed and uniform temperature, which may be 75 deg. F. or any other temperature. If the cold junction of a thermo-couple is at 75 deg. F. and the hot junction in the furnace is at 1,400 deg. F., the actual millivoltage generated is proportioned to the difference in temperature between the hot end and the cold end of the thermo-couple, equivalent to 1,325 deg. F. If we heat this cold junction to 100 deg. F. we will then only have a millivoltage produced by the thermo-couple equivalent to the difference in temperature of 1,300 deg. F. instead of 1,325 deg. F., as previously cited.

The effect of heating the cold junction of a base metal thermo-couple is such that with a rise in temperature of the cold junction of 25 deg. F. the instrument will read approximately 25 deg. low. With a platinum thermo-couple this error is approximately one-half. In other words, with a platinum couple, the error would amount to only approximately 12 deg. F. for a rise in temperature of the cold junction of 25 deg. F. above normal.

In the use of any thermo-electric pyrometer it is essential that this point be realized, because far too many thermo-electric pyrometers are still in use today with the old junction of the thermo-couple located high above a furnace and subject to constant changes in temperature and to probably a normal temperature of not less than 200 deg. F.

Assuming that the pointer on the instrument is set at 75 deg. F., such an instrument is actually reading 125 deg. too low. Of course, if the user of the instrument only realizes this fact he will set the pointer of his instrument for the proper cold junction temperature 200 deg. F. instead of that usually adopted in supplying the pyrometer, 75 deg. F.

All modern pyrometers are equipped with zero adjusters which permit of setting the pointer to any desired cold junction temperature and this point can be readily taken care of. Unfortunately in the case where a thermo-couple is located just above the furnace, when the furnace is first started up, the temperature of the thermo-couple inside might attain 1,400 deg. F. and the cold junction outside will have only reached 100 deg. F.; after the furnace has been run six hours, the heat radiation from the crown of the furnace may be such that the cold junction temperature will reach 200 deg. F. In consequence, the pyrometer is reading 100 deg. lower than it did formerly for exactly the same temperature in the furnace. In consequence, the operator in order to make the pyrometer read the desired temperature, 1,400 deg. F., is actually carrying 1,500 deg. F. in the furnace.

COLD JUNCTION COMPENSATION

There are a number of ways in which this source of error due to changes in temperature of the cold junction of the thermo-couple are overcome. First, compensating leads, as they are called, consisting of material the same as that forming the thermo-couple, which will remove the cold junction to some distant point where the temperature will be constant. These compensating leads can be selected of material the same as the thermo-couples or of the other alloys which will offset the effect of change in temperature at the cold end of the thermo-couple.

There are several ways in which we can further reduce this possible error. First, we can run the compensating leads into a pipe driven into the ground for some 10 ft. and at the bottom of the pipe we make our junction with the copper leads running to the instrument. The cold junction is now in the ground where the changes from winter to summer under usual conditions vary 5 deg. F. Where precautions are taken this is an excellent method of maintaining a constant cold junction temperature.

Another common method is to place the cold end of the compensating leads in a compensating box, which consists of a thermostat and lamps or heating units. By means of the thermostat it is possible to maintain any desired temperature usually up to 150 deg. F. within a limit of + or — 2 deg. F. The ordinary compensating box is designed to take care of as many as 20 thermo-couples, which are led into the one compensating box and this affords an easy method of maintaining a constant temperature.

The compensating leads from the thermo-couples can also be run to the instrument, which may be located in the room subject to variation in temperature from probably 70 to 100 deg. F. from winter to summer. In this case it is possible to have an error of as much as 30 deg. F.

Thermo-electric pyrometers are now supplied with automatic compensating means at the instrument so that, provided the compensating leads are run to the instrument, automatic compensation takes place to overcome changes in temperature at the instrument itself. This compensation can be readily incorporated in the thermo-electric pyrometers through a shunt of large temperature coefficient, which will be materially affected with atmospheric changes in temperature.

BASE METAL THERMO-COUPLES

I have referred previously to the use of thermo-couples formed of base metal and of platinum wire. Base metal thermo-couples are almost universally used for measuring temperatures to 2,000 deg. F. or 1,100 deg. C. These base metal thermo-couples for temperatures up to 1,200 deg. F. or 650 deg. C. are usually formed with one wire of constantan, a nickel copper alloy, and the other a pure iron. This form of thermo-couple is advantageous for use in a reducing atmosphere within the above temperature limits. For temperatures above 1,200 deg. F. up to 2,000 deg. F., equivalent to 650 deg. C. or to 1,100 deg. C., a thermo-couple formed of one wire of 90 per cent nickel and 10 per cent chrome and the other wire of 98 per cent nickel with balance manganese, silicon and aluminum, would give the most satisfactory service.

Base metal thermo-couples as supplied today are furnished in all diameters from .01 in. up to ¼ in. in diameter; sensitive thermo-couples of wire .01 in. in diameter can be used experimentally to advantage in testing the temperature of the surfaces of metal, particularly at moderate temperatures, whereas thermo-couples formed of wire ⅛ in. or ¼ in. in diameter are better suited for constant service in large heat-treating furnaces.

PLATINUM THERMO-COUPLES

Where we have to measure temperatures from 2,000 deg. F. or 1,100 deg. C. up to a maximum of 3,000 deg. F. or 1,000 deg. C., it is best to use a platinum rhodium thermo-couple, one wire being of pure platinum and the other platinum 90 per cent and rhodium 10 per cent. The wires forming this thermo-couple are usually .02 in. in diameter. A platinum rhodium thermo-couple gives very satisfactory life even under severe service at temperatures up to 2,500 and 2,600 deg. F., provided the wires are suitably protected from the gases with a tube of porcelain or silica, which is impervious to gases. These tubes are in turn protected with a tube of graphite, carborundum, fire brick or other suitable material which serves to protect the fragile porcelain or silica tube from mechanical injury and introduces a slight lag to prevent breakage through contraction and expansion due to sudden changes in temperature.

While it is of the utmost importance to properly protect a platinum rhodium thermo-couple to exclude gases which very actively attack the platinum, it is equally desirable to properly protect a base metal thermo-couple if maximum life is to be secured. The usual method of protecting a thermo-couple for temperatures up to 1,400 deg. F. (750 deg. C.) or below, is to use a common wrought iron pipe with the lower end plugged or welded. The life of common wrought iron pipe can be increased to some extent by calorizing, a process of impregnating the pipe with an aluminum oxide.

A material increase in the life of base metal thermo-couples for temperatures above 1,400 deg. F. or 750 deg. C. is secured by the use of protecting tubes of nickel chromium or of a special alloy. The nickel chromium tubes withstand to a satisfactory extent normal use in heat treating furnaces where the temperature does not exceed 1,600 deg. F., but for the most common conditions, and where maximum life is secured this special alloy tube is giving the best results.

To insulate the wires forming a thermo-couple from each other and from the protecting tube, it is common practice to use beads of porcelain or lavite, which are the most satisfactory for this service. Formerly asbestos tubing or string was used to insulate each wire and this was painted with a solution of sodium silicate and carborundum, but this form of insulation rapidly disintegrates at temperatures above 1,000 deg. F. The porcelain or lavite insulation is most certainly to be recommended.

STANDARDIZED VOLTAGE FROM THERMO-COUPLES

A platinum rhodium thermo-couple, on account of the care taken in the refining of the precious metals and the proper alloying, can be reproduced continuously with the same millivoltage. As new ingots are cast every few years from which this wire is drawn, it has been possible to carefully duplicate these ingots so that the millivoltage is reproduced within some 5 deg. F. of the millivoltage produced by a previous lot.

With base metal thermo-couples it has been extremely difficult to select wires which will accurately reproduce the standard millivoltage of a certain base metal thermo-couple. It seems that the limit in this respect is approximately 15 deg. plus or minus or a total possible error of 30 deg. F. We have, however, made some progress through special care in selecting wire producing the desired millivoltage, and it is possible today to supply wire for thermo-couples with an accuracy within 10 deg. F. plus or minus.

Where extreme accuracy is required it is possible to shunt the thermo-couples to a definite or standard millivoltage by reducing the voltage produced by the thermo-couple by some two millivolts. With this method it is possible to standardize any thermo-couple with extreme precision and an accuracy within plus or minus 4 deg. F. can be easily obtained.

A shunted thermo-couple can be used to advantage where the immersion of the thermo-couple in the furnace does not exceed 18 in. For unusual immersions where the thermo-couple must project, for example, several feet inside the furnace, the unshunted thermo-couple is preferable. Where the shunted thermo-couple is used it has the advantage that it is possible to re-standardize this thermo-couple at any time provided it falls off in voltage. With the unshunted thermo-couples should this occur, it must be either junked or shortened if this is possible.

The shunted thermo-couple has the disadvantage that the shunt may be broken accidentally or through mechanical injury. Both the shunted and unshunted thermo-couples have their advantages and disadvantages and each has its uses.

There are two common methods of measuring the voltage produced by the thermo-couple, the milli-voltmeter method and the potentiometer method.

THE MILLI-VOLTMETER METHOD OF MEASURING TEMPERATURE

The milli-voltmeter method has been in use for a great many years. The original milli-voltmeters were constructed with a movable element swinging in the airgap of a permanent magnet and hung by a fine suspension wire. As a platinum thermo-couple produces some 20 thousandths of a volt for 3,000 deg. F. and a base metal thermo-couple some 40 thousandths for 3,000 deg. F., the usual temperature scale, the internal resistance of an instrument is dependent on the type of thermo-couple used and the voltage is consequently available.

These suspension type instruments which were largely made in France, England and Germany some 20 or more years ago, had an internal resistance of 300 to 600 ohms with a platinum thermo-couple with full scale of 20 millivolts. On account of the delicate construction of these instruments and the continual breakage of the suspension wires, certain manufacturers in this country produced a low resistance form of milli-voltmeter pyrometer consisting of the standard form of switchboard or portable milli-voltmeter used with a shunt as an ammeter. This instrument usually had from 3 to 5 ohms internal resistance. While it was true that such an instrument was exceedingly robust and could be handled without likelihood of injury, it was equally true that the accuracy of such an instrument was exceedingly poor on account of the low internal resistance of the instrument. Frequently the total resistance of the thermo-couple and the leads connected to such an instrument might vary from a total of 1 ohm to 2 ohms, affecting the actual readings of the instruments as much as 20 per cent.

If an instrument of this kind was calibrated for a 3-ft. thermo-couple of the usual ⅛-in. wire and it had later to be used with a 4-ft. thermo-couple, unless the instrument was re-calibrated it read 20 deg. F. too low. If the instrument was calibrated from 25-ft. double conductor No. 12 gage copper leads and it had later to be located at a greater distance where 75 ft. of the above leads were required, the instrument read some 18 deg. F. too low. Under such conditions it was absolutely impossible to secure any precision in measuring temperature.

In the past five or six years, high resistance milli-voltmeter pyrometers have been developed with an internal resistance with a platinum couple of as high as 600 ohms or with a base metal thermo-couple as high as 1,200 ohms, which have a standard double pivoted construction used in the ordinary low resistance instrument.

Where an instrument of 600 ohms resistance is used, a change in line resistance from 5 ft. to 500 ft., which is naturally very excessive, will affect the readings of the pyrometer only 4 deg. F. where the scale is graduated to 2,000 deg. F. Any likely change in the length of the thermo-couple has absolutely no effect on the readings of such a pyrometer.

In the last couple of years, instruments have been brought out in which the effect of line resistance can be entirely eliminated by balancing the voltage of the thermo-couples against that of another source of electromotive force such as a dry cell. Usually an adjustable resistance is installed for a total of 15 ohms and any variation in line resistance can be compensated for in this type of instrument up to a total of 15 ohms. After this adjustment has been made, the instrument is direct reading and independent of line resistance.

Messrs. Harrison and Foote of the Bureau of Standards, Washington, have recently hit upon a method of accomplishing this result by using the voltage of the thermo-couple itself. This new instrument requires no dry cell or standard cell as a source of electromotive force. The instrument is similar to the ordinary milli-voltmeter in appearance, with the addition of the small key and resistance knob. The operator has only to read the temperature in the usual way. He presses the key and if the reading is any different from that which was previously observed, he turns the resistance knob until there is no change, whether the key

Exhibit at Convention of American Steel Treaters Society is depressed or not. The instrument has then been adjusted for line resistance, which may be any amount whatsoever up to 15 ohms, equivalent to many miles of copper leads. What little temperature coefficient exists in the ordinary high resistance milli-voltmeter is balanced out in this instrument. Accuracy in calibration of an instrument of this kind can be guaranteed within 1/10 of a milli-volt equivalent on the base metal scale of 4 deg. F.

THE POTENTIOMETER METHOD OF MEASURING TEMPERATURE

The potentiometer method of measuring the voltage produced by a thermo-couple has been quite extensively adopted in the past six or eight years where extreme precision is required. The potentiometer method differs from the milli-voltmeter method in that the milli-voltmeter uses the current produced by the thermo-couple to deflect the instrument. The potentiometer opposes the current of the thermo-couple to that of a dry cell and the dry cell current, equivalent to that of the thermo-couple, is measured in the usual way.

A galvanometer is used to indicate the point at which no current is flowing, and when the pointer on the galvanometer indicates zero, the voltage of the dry cell is equivalent to that of the thermo-couple. The line resistance from the dry cell to the galvanometer is exceedingly small and constant. When the thermo-couple voltage has been opposed to the voltage of the dry cell and balanced, the actual measurement is that of the dry cell circuit. Hence this measurement is entirely independent of the resistance of the circuit including the thermo-couple, lead wires and galvanometer resistance.

The potentiometer can be used with any length of leads desired, and the indications are entirely independent of line resistance or changes in resistance due to atmospheric changes in temperature along the leads. The potentiometer has a disadvantage as compared with the milli-voltmeter method of temperature measurement in that some outside source of current, a dry cell and standard cell, for example, are necessary as a source of current and the dry cell must be replaced from time to time. The standard cell likewise is liable to injury if subjected to temperatures below 40 deg. or above 104 deg. F. and the standard cells must be checked occasionally.

RECORDING PYROMETERS

Potentiometer pyrometers are available in recording form, in which the mechanism automatically balances the voltage of the cell against that of the thermo-couples, and in this instrument the records are automatic and no hand balancing is required.

In either the milli-voltmeter or in the potentiometer type, recording pyrometers are available to plot a continuous record of the temperatures on a chart daily, weekly or monthly, as desired. The recording pyrometers are supplied either to make a single record on a chart, or with two or more galvanometers side by side making individual records on one recording sheet. Multiple recording pyrometers are also available incorporating a switching mechanism, which alternately connects the various thermo-couples to the galvanometer or milli-voltmeter in a recording instrument, and many records can be secured on one chart. This is a distant advantage in certain cases.

Where a recording instrument operates on the milli-voltmeter method, the frictionless type of recorder is required, and the pointer is depressed only momentarily at intervals on the recording chart. In the potentiometer type of recorder, sufficient power is available from the motor operating the instrument to imprint a record directly on the recording chart.

SIGNALING PYROMETERS

Automatic signaling pyrometers have been used for some years in the larger heat-treating plants where it is desirable that the operator should not decide, but should be signaled by lights, as to whether the temperature is within the correct limits. For some years it has been common practice to install a central indicating pyrometer with switchboard, and by means of three colored lights at each furnace, usually red, white and green, to signal from the central station whether the temperature is too low, correct, or too high. Usually 25 deg. F. is considered a limit within which the temperature should be maintained.

The white light burns when the temperature is correct. If the temperature drops below, the green light glows, or if it rises above the desired temperature the red light burns. A step farther is the automatic signaling of the temperature by an automatic signalling pyrometer which can be incorporated in the standard form of milli-voltmeter pyrometer giving instantaneous readings.

AUTOMATIC TEMPERATURE CONTROL PYROMETERS

The day when the furnace temperatures will be accurately controlled automatically is coming very rapidly and notable progress has been made in this respect during the last few years. The application of automatic control pyrometers to electric furnaces is a comparatively easy problem, as automatic switches can easily be operated by a solenoid which can in turn be operated by the same contact device in the pyrometer as used in the signaling instrument. We have applied automatic temperature control to electric furnaces most successfully and some 100 electric furnaces to my knowledge are being controlled automatically at present. This control may be secured by the opening and closing of the main circuit or line, or by cutting in and out a small portion of the available current.

Automatic control of gas fired furnaces is a little more difficult, as a gas valve to be tight and not leak under continual operation, must be well packed and considerable power is required to operate the valve. We have, however, by the use of powerful solenoids or by motor operated valves, been able to overcome this, and we have a number of gas-fired furnaces of large dimensions which are automatically controlled.

There is no question that within the next year or two the automatic control of furnace temperatures will be very generally adopted wherever a constant temperature is to be maintained and it is desirable to eliminate the human element and hand control.

THE PART PYROMETERS PLAY IN STEEL TREATMENT

Many are not aware of the part pyrometers play in steel treatment from the smelting of the iron until the finished product. Let us take a part made from high grade alloy steel. First in the blast furnace where the iron is smelted; the hot blast temperatures and the temperature of the escaping gases from the furnace are accurately controlled by thermo-electric pyrometers. Next, the open hearth furnace where the steel is refined. Temperatures are very largely controlled in these furnaces by installing a platinum thermo-couple in the slag pocket or the gases from the checker brick. A very satisfactory record can be secured on a recording pyrometer of the working of the open hearth furnaces in this indirect manner. Optical pyrometers are also used to focus on the molten steel in the furnace or on the steel in pouring. This form of pyrometer has not come into general use.

The forging of steel carried on in forging furnaces at a temperature of around 2,300 deg. F. is accurately controlled with the aid of thermo-electric pyrometers, using platinum thermo-couples with special tubes.

The annealing, hardening, re-heating and the quenching temperatures are realized by everyone to be of the utmost importance and should be accurately controlled with pyrometers. Where oil or water is used for quenching, recording thermometers or resistance thermometers are applied to advantage.

While we are continually striving to improve pyrometers and to design these instruments to better meet each requirement, our efforts are a failure provided we cannot educate the users of pyrometers in how to use and care for them.

The best of pyrometer installations often give unsatisfactory results simply because it was assumed that when pyrometers were installed that the steel in some miraculous manner would come out perfectly heat-treated without any attention whatsoever. The pyrometers were apparently supposed to be infallible, and while a watch has to be wound and adjusted occasionally the pyrometer should require no such attention. There are no pyrometers produced today which do not require some attention.

If you install pyrometers, take the time to make a little study of how the instruments operate, how they can best be installed, and how they are to be cared for after they are in use in your plant. If you have quite a number of furnaces and a considerable pyrometer installation, place a man in charge of the instruments who has been first instructed in the information anyone should have to handle such a job. Do not take an office boy to look after your pyrometer equipment as I have seen so often done. A first class pyrometer equipment will pay for itself time after time during the year, and will be of infinite benefit to the user provided, first, it is properly designed to meet the conditions; second, it is properly installed; third, it is properly understood and cared for.

PRACTICAL INFORMATION CONCERNING HIGH SPEED STEEL

BY ROY C. McKENNA
President, Vanadium-Alloys Steel Company, Latrobe, Pa.

The manufacturer of high speed steel, knows and appreciates the troubles and difficulties that may sometimes arise in the heat treating of his product. The manufacturer's aim is to make a uniform high speed steel which will best meet the requirements of the average machine shop on general work, and at the same time allow the widest variation in heat treatment to give desired results.

High speed steel is one of the most complex alloys known. A representative high speed steel contains approximately 24 per cent of alloying metals, namely: tungsten, chromium, vanadium, silicon, manganese, and in addition there is often found cobalt, molybdenum, uranium, nickel, tin, copper and arsenic.

COMPOSITION OF HIGH SPEED STEEL

The selection of a standard analysis by the manufacturer is the result of a series of compromises between various properties imparted to the steel by the addition of different elements. There is a wide range of chemical analyses of various brands of high speed steel. Although there are being manufactured as high speed steel, brands that do not come within the standard of what is commercially known as high speed steel, there are certain well defined limits to the contents of certain elements.

The steel, to be within the range of generally accepted analysis should contain over 16 per cent and under 20 per cent tungsten. If of lower tungsten content it should carry proportionately more chromium and vanadium. Further discussion in this paper is confined to high speed steels containing approximately 18 per cent tungsten.

The combined action of tungsten and chromium in steel gives to it the remarkable property of maintaining its cutting edge at relatively high temperature. This property is commonly spoken of as "red-hardness." The percentage of tungsten and chromium present should bear a definite relationship to each other. Chromium imparts to steel a hardening property similar to that given by carbon, although to a less degree. The hardness imparted to steel by chromium is accompanied by brittleness. The chromium content should be between 3½ and 5 per cent.

Vanadium was first introduced in high speed steel as a "scavenger," thereby producing a more homogeneous product, of greater density and physical strength. It soon became evident that vanadium used in larger quantities than necessary as a scavenger, imparted to high speed steel a much greater cutting efficiency. Recently, no less an authority than Professor J. O. Arnold, of the University of Sheffield, England, stated that "high speed steels containing vanadium have a mean efficiency of 108.9, as against a mean efficiency of 61.9 obtained from high speed steel without vanadium content." A wide range of vanadium content in high speed steel from ½ to 1½ per cent, is permissible.

An ideal analysis for high speed steel containing 18 per cent tungsten is a chromium content of approximately 3.85 per cent; vanadium .85 per cent to 1.10 per cent and carbon between .62 and .77 per cent.

INGREDIENTS WHICH ARE DETRIMENTAL

Sulphur and phosphorus are two elements known to be detrimental to all steels. Sulphur causes "red-shortness" and phosphorus causes "cold-shortness." The detrimental effect of these two elements counteract each other to some extent but the content should be not over .02 sulphur and .025 phosphorus. The serious detrimental effect of small quantities of sulphur and phosphorus is due to their not being uniformly distributed, owing to their tendency to segregate. The contents of manganese and silicon are relatively unimportant in the percentage usually found in high speed steel.

The detrimental effects of tin, copper and arsenic are not generally realized by the trade. Small quantities of these impurities are exceedingly harmful. These elements are very seldom determined in customers' chemical laboratories and are somewhat difficult for public chemists to analyze for.

In justice to the manufacturer of high speed steel, attention should be called to the variation in chemical analyses between the best of laboratories. Generally speaking, a steel works laboratory will obtain results much nearer true and accurate than is possible by a customer's laboratory, or public chemist. This can reasonably be expected for the steel works' chemist is a specialist, analyzing the same material for the same elements day in and day out.

METHOD OF MANUFACTURE IS IMPORTANT

The chemical composition of steel for any purpose is a basic consideration and must be such as will meet the requirements, but the quality of the steel does not depend wholly upon the chemical composition. Assuming the chemical composition to be within the permissible limits, the quality depends upon local conditions surrounding its manufacture. If the quality of steel were entirely dependent upon the chemical composition and not influenced by its working and handling in accordance with tool steel practice, the tool steel industry would be unable to exist.

The successful manufacture of high speed steel can only be obtained by those companies who become specialists. The art and skill necessary in the successful working of such steel can be attained only by a man of natural ability in his chosen trade, and trained under the supervision of experts. To become an expert operator in high speed steel in any department of its manufacture, it is necessary that the operator works almost exclusively in the production of such steel.

As to the heat treatment of high speed steel, it is customary for the manufacturer to recommend to the user a procedure that will give to his steel a high degree of cutting efficiency. The recommendations of the manufacturer should be conservative, embracing fairly wide limits, as the tendency of the user is to adhere very closely to the manufacturer's recommendation. Unless one of the manufacturer's expert service men has made a detailed study of the customer's problem, the manufacturer is not justified in laying down set rules, for if the customer does a little experimenting he can probably modify the practice so as to produce results that are particularly well adapted to his line of work.

GENERAL PRACTICE IN HARDENING

It is not the writers' intention to make any definite recommendations as to the heat treating of high speed steel by the users. It is recognized that such steel can be heat treated to give satisfactory results by different methods. It is, however, believed that the American practice of hardening and tempering high speed steel is becoming more uniform. The trend of American practice for hardening high speed steel is towards the following: First: Slowly and carefully preheat the tool to a temperature of approximately 1,500 deg. F., taking care to prevent the formation of excessive scale. Second: Transfer to a furnace, the temperature of which is approximately 2,250 deg. to 2,400 deg. F., and allow to remain in the furnace until the tool is heated uniformly to the above temperature. Third: Cool rapidly in oil, dry air blast, or lead bath. Fourth: Draw back to a temperature to meet the physical requirements of the tool, and allow to cool in air.

It was not very long ago that the desirability of drawing hardened high speed steel to a temperature of 1,100 deg. F. was first pointed out, and it is indeed encouraging to learn that comparatively few treaters of high speed steel have failed to make use of this fact. Many steel treaters at first contended that the steel would be soft after drawing to this temperature and it is only recently, since numerous actual tests have demonstrated its value, that the old prejudice has been eliminated.

With an understanding of some of the difficulties inherent in the manufacture of high speed steel, I will try to give you the justification of some of the trade practices and customs which have been generally accepted.

DISCUSSION OF TRADE PRACTICES

High speed steel should be delivered only in the annealed condition because annealing relieves the internal strains inevitable in the manufacture and puts it in vastly improved physical condition. The manufacturer's inspection after annealing also discloses defects not visible in the unannealed state.

The only true test for a brand of high speed steel is the service that it gives by continued performance month in and month out under actual shop conditions.

The value of the file test depends upon the quality of the file and the intelligence and experience of the person using it. The file test is not reliable, but in the hands of an experienced operator, gives some valuable information. The manufacturer of small tools from high speed steel sometimes carries the file test to extremes. Almost every steel treater knows of numerous instances where a lathe tool which could be touched with a file has shown wonderful results as to cutting efficiency.

The practice of buying high speed steel by brand names is justifiable. The guarantee behind high speed steel is the standing and reputation of the manufacturer, who should maintain in his employ metallurgists and experienced service men who will be ready at any time to heat-treat and demonstrate to the buyer's satisfaction that the product furnished will meet any reasonable requirements. The customer's specifying the chemical, physical or metallurgical properties relieves the manufacturer of his responsibility as to quality. Quality is not dependent upon the chemical composition and poor high speed steel can be made within any limits of chemical content that could be commercially met by a manufacturer of best quality high speed steel. In purchasing high speed steel by brand name the buyer places responsibility for performance clearly with the manufacturer. The specifying of phyiscal, chemical or metallurgical limits by the buyer would lead to endless controversy and would positively retard, in fact, completely arrest the progress of the industry.

The manufacturers of high speed steel should co-operate to the extent of submitting upon request rejection limits as to chemical content of those elements which vitally affect the steel treater's work. It is not desirable that the manufacturer's rejection limits be published broadcast. The buyer has the right to demand that high speed steel purchased by him should be within the generally accepted analysis of high speed steel. Chemical composition is a basic consideration, but the quality is dependent upon many other factors, the most important of which is the human element. No steel treater can question the fact that the results obtained from heat-treating depend upon the operator. The operator will use all modern appliances, such as pyrometer, automatic temperature control, quenching machines, etc., but the results obtained depend upon his individual experience and skill. The manufacture of tool steel is and will continue to be a handicraft industry.

Modern tool steel practice has changed from that of the past, not by the use of labor-saving machinery, but by the use of scientific devices which aid and guide the skilled craftsman in producing a steel of higher quality and greater uniformity. It is upon the intelligence, experience and skill of the individual that the quality of tool steel depends.

ELECTION OF OFFICERS

The following national officers of the society were elected: president, T. E. Barker, Miehle Printing Press & Manufacturing Company, Chicago; first vice-president, E. J. Janitzky, Illinois Steel Company, South Chicago; second-vice-president, D. K. Bullens, Cann & Saul, Royersford, Pa.; secretary, Arthur G. Henry, Illinois Tool Works, Chicago; treasurer, A. F. Boissoneau, William Ganschow Company, Chicago; directors, H. G. Weidenthal, James H. Herron Co., Cleveland, Ohio; A. F. MacFarland, Vanadium-Alloys Steel Company, Latrobe, Pa.; J. Fletcher Harper, Allis-Chalmers Company, Milwaukee, Wis., and J. O. Pollak, Pollak Steel Company, Cincinnati, Ohio.

On September 25 a banquet was held at the Morrison Hotel which 620 members and guests attended. Addresses were delivered by J. W. O'Leary of A. J. O'Leary & Son, Chicago; Doctor H. Marion Howe, consulting metallurgist and scientific attaché to the American Peace Commission; and Professor J. W. Richards, professor of metallurgy at Lehigh University.

Air Power for Driving Locomotives.—A recent issue of the New York Times contains a special dispatch from Rome describing an invention for driving locomotives by air power, which has been submitted to the Italian State Railways by a young Italian engineer. The secret of the invention lies in a new system of compressed air by which big central tanks may store enormous power to be distributed to "fuel" stations along the railway lines by strong pipes. Steam is superseded, coal, water power and electricity are no longer needed. The inventor claims his system is cheaper and its adapatability to railway systems quicker than any other existing. Steam locomotives can be used almost without changes, only the coal tender must be converted into an air tank. In the new scheme the main expenditure is for the building of big plants for compressing air and the laying of pipes, all of which is said to be vastly cheaper than electrical installation. It is not stated where the compressor power is to come from.

Setting Locomotive Valves

Instructions for Setting Walschaert, Young and Stephenson Gears; Simple Individual Operations

By L. D. FREEMAN

THE railroads are spending considerable money and effort on fuel economy, but at the same time do not pay enough attention to correct valve setting and steam distribution, and frequently by the wasteful use of steam more than offset the economies of efficient steam generation.

There are two reasons why locomotives of the same class in the same state of repairs do not pull the same tonnage at the same speed over the same division. The first reason is different valve events, and the second, enginemen do not have the reverse lever in the proper notch to produce maximum drawbar pull under given conditions. This latter cause was thoroughly investigated by B. B. Milner, engineer motive power, New York Central Lines, and published in the *Daily Railway Age* of June 25, 1919.

To secure more uniform and efficient results, simple instructions have been worked out for valve setting and have had considerable success in use on the Seaboard Air Line.

The object of these instructions for valve setting was to investigate the different valve events possible with the existing parts on each different class of locomotive; to adopt the setting best suited to that class of locomotive; by means of fixed gages to enable any mechanic of ordinary skill not only to set the valves with the least amount of work, but to duplicate the setting on any number of locomotives at any future time; and to so divide the work into simple individual operations that any mechanic could perform the different operations even if he did not possess the skill to do so without definite instructions.

The expert valve setter of 10 or 15 years ago has almost entirely disappeared, due principally to the flat rate for all mechanics of the same craft removing the incentive of extra compensation for diligent study of the art.

Correct valve setting depends on the ability of the valve setter to identify the various defects in the assembling of a valve gear on each locomotive and to make such corrections as are necessary to produce the desired valve events.

Numerous details that had to be worked out do not appear in the instructions, but are described in detail under the heading of each kind of gear.

GENERAL CONDITIONS

Maximum valve travel—In full gear for slide valves and outside admission piston valves, limit the maximum travel

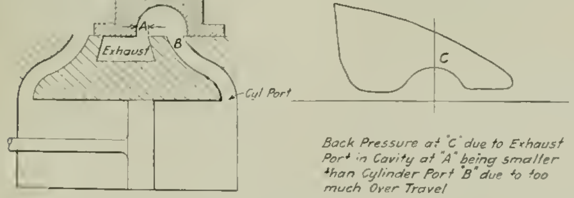


Fig. 1—Indicator Card Showing Restriction of Exhaust Caused by Over Travel

to twice the lap, plus twice the steam port opening, plus ¼ in.

Many slide valve engines over travel so far that the steam pressure under the lower face unbalances the valve, causing it to lift off the seat and blow through the exhaust. While this occurs only with the reverse lever in full gear, either way, it is a condition that is very difficult to detect.

A more common disturbance caused by the over travel is that the valve moves so far off center that the exhaust cavity partly closes and restricts the exhaust at about half stroke, builds up back pressure and makes an indicator card with a "hump" in the exhaust line as shown in Fig. 1. It was usually claimed that this was due to the exhaust "blowing over" the bridge in the exhaust stand, but that this could not be the cause is evident, since this defect has not been found in all engines using the same design of exhaust stand.

Steam Lap—This should be as large as possible, since the larger the steam lap, the larger the exhaust port opening will be for any given valve travel. For example: with 5/16 in. steam port opening at shortest cut-off, with one inch lap, the exhaust port opening is 1 5/16 in., while if the lap can be 1¼ in. the resultant steam port will be 1 9/16 in., or nearly 20 per cent increase and consequently a "smarter" engine is obtained.

Exhaust Lap—The exhaust lap simply holds the steam later than necessary to get useful work from it, and makes it more difficult to get rid of the exhaust, building up back pressure that offsets any gain in useful work and therefore is not to be recommended.

Exhaust Clearance—At high speeds it is necessary to have the exhaust open earlier to get rid of the steam and stay open later to prevent excessive compression. With slide valves on fast freight engines 1/32 in. will take care of the exhaust. Should any excessive compression occur the slide valve is unbalanced and blows through into the exhaust. With piston valves it is necessary to give about 3/32 in. to protect against excessive compression.

For passenger locomotives, an exhaust clearance of 1/16 in. should be allowed for slide valves and ⅛ in. to 3/16 in. for piston valves, depending on the speed at which the locomotive is to operate.

Maximum Cut-off—Lay out Zeuner valve diagram for each class of locomotive and arrange lap, lead and valve travel so that the maximum cut-off is 85 per cent of the stroke, taking advantage of any chance to increase steam lap with a given travel.

Minimum Cut-off—To prevent excessive strains to the machinery, limit the minimum cut-off to 20 per cent of stroke, handling the throttle to reduce drawbar pull below this limit.

WALSCHAERT GEAR

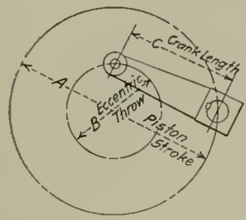
Lead should be limited so that the crosshead is within one inch or less of the end of stroke before the combination lever opens the valve for lead. Limit the lead to ¼ in.

Locomotives having Walschaert valve gear are designed for constant lead at all position of the reverse lever and should be so set unless ordered to be set with variable lead on passenger locomotives. In any valve gear obtaining motion from the crosshead and a crank arm on the main pin, the combination of these two movements gives the desired valve events. Lap and lead travel comes from the crosshead and is in complete control of the valve when the main pin is on either front on back dead center. In this position the crank arm is on the top or bottom quarter and has no control over the valve. The crank arm passing through a given circle *B*, Fig. 2, has full control over the valve at full travel in any position of the reverse lever.

Before attempting to set valves it is first necessary to prove that all parts are in accordance with the drawings for that class of engine.

First Operation—Set the crank correctly as shown in Fig. 2.

Second Operation—Prove the length of the reach rod. Set the reverse lever in vertical position and plumb the reverse shaft. Measure the true length of the reach rod at *D*, as in Fig. 3.



Engine Number New	Engine Number Old	Class	A	B	C
645-649 Constant	46-50 Lead	L-2	28"	15 5/8"	16
645-649 Variable	46-50 Lead	L-2	28"	15 5/8"	16 5/8"
778-787	778-787	L-4	28"	15 5/8"	16"
763-777	763-777	L-4	28"	17 1/2"	17"

Fig. 2

Third Operation—Prove the length of the radius bar hangers. Place the reverse lever on center with the proper

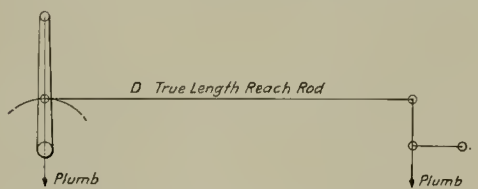


Fig. 3

length of roach rod. After proving that the lifter arms are parallel, swing the link back and forth and adjust hangers *E* until a still valve is obtained, as in Fig. 4.

It is not necessary to place valve rollers under each engine. All adjustments can be made by trailing with another

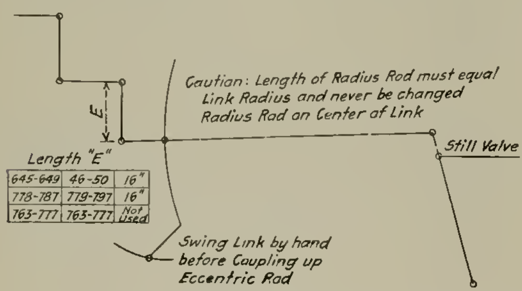


Fig. 4

engine. The most common error in valve setting is to attempt to make all changes with one trailing. It is absolutely necessary that the engine be trailed twice, once to adjust the lead and once to adjust the cut-off.

Fourth Operation—Adjust the lead, change the valve rod, place the reverse lever on center and trail the engine; adjust the valve rod to equalize the lead on both sides of the port marks. No further change can be made on the valve rod. The valve rod must be changed before trailing for the cut-off.

Fifth Operation—Adjust the cut-off, change the eccentric rod, trail the engine with the lever at half stroke and equalize the cut-off on the eccentric rod. To find the amount of change, multiply the change desired by the distance from the link center to the center of the eccentric rod pin and divide by the distance from the link center to the center of the link block. See Fig. 5.

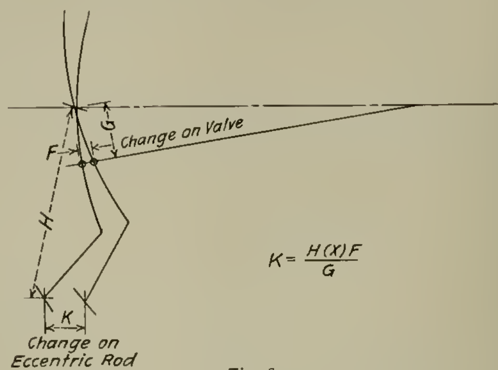


Fig. 5

The method of compiling valve data for engines having Walschaert valve gear is shown in the following table:

Engine class	Max. valve travel, in.	Steam lap, in.	Lead, constant, in.	Exhaust clearance, in.
L-2	6	1 1/8	1/4	3/32
P-1	6 1/2	1 1/16	3/16	3/16
L-5	5 1/2	1	3/16	....
L-4	6 1/4	1 1/8	1/4	3/64
L-4	6	1 1/8	1/4	3/32
P-1	6 1/2	1 1/16	3/16	1/8
H-1	6	1	3/16	....

STEPHENSON GEAR

Back set the saddle pin as in Fig. 6. This is not an exact science, that is, there is no absolute definite point that can be calculated. O. W. Young, formerly valve gear designer for the American Locomotive Company, made extensive experiments on a full size model and the conclusion reached was that back set calculated in accordance with his formula published in the *Railway Age Gazette*, Mechanical Edition, page 647, December, 1913, was close enough for all practical purposes, but could be varied as much as 1/4 in. without detrimental results. This has been proved by investigation of engines in actual service.

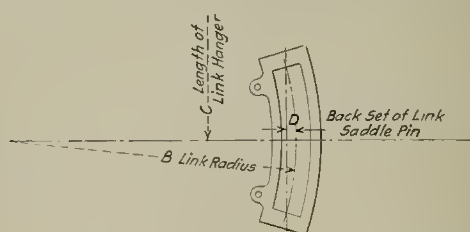


Fig. 6

Data Used With Figure 6

Engine class	A, in.	Reverse shaft, in. Top arm B	Reverse shaft, in. Link arm C	Rocker arms, in. Valve end	Rocker arms, in. Link end
G-1	9 1/2	23	18	11	9 3/4
G-2	6 1/2	23	17 1/2	11 1/2	10
H	2 1/2	22	15	13 1/2	11 1/4
L-4	1 1/2	18	18	11 1/4	10 1/4
L-5	2 1/4	20	17	11 1/4	10 1/4
L-2	2 1/8	27	18	18 1/2	16 1/4
L-2	2 1/2	27	18	17 1/8	16 3/8
L-3	2 1/2	25	17	13	10
L-4	2 1/2	27	18	18 1/2	16 1/4
L-4	2 1/2	27	18	18 1/2	16 1/4
L-5	2 1/2	27	18	12 1/2	11 1/2

The proportions of the link determine the amount the lead increases from full to mid gear and in many cases of the older Stephenson link engines, this increase of lead amounts to from 7/16 in. to 9/16 in., which means that with the reverse lever on center, the smallest possible port opening is 7/16 in. to 9/16 in., or whatever the increase amounts to, if set line and line in full gear. The shortest possible cut-off under these conditions is frequently 33 per cent of the stroke, which is entirely too much and is wasteful in the use of steam. It makes a sluggish engine as well, due to too great a volume of steam to get rid of through the limited exhaust port opening at short cut-off travel.

Data Used With Figure 6

Engine, Class	Link radius B, in.	Link hanger C, in.	Saddle pin backset D, in.	Link print	Valve travel, in B. P.	Valve travel, in Limit to
G-2	60	16¼	½	2161-D	5¾	5¼
H	44¾ 40	19¾	1⅝	3009-D	6	6
I-4	45	17¼	1	1034-D	5 7/16	5⅜
I-4	45	17¼	1	1034-D	5 7/16	5⅜
I-5	45¾	....	11/16	2981-C	5 7/16	5⅜
L-2	56	18½	13/16	3009-D	6¼	6¼
L-2	56	18½	21/32	2589-C	6	6
L-3	46	18⅞	1⅜	2589-C	6½	6½
L-4	56	18½	13/16	3009-D	6¼	6¼
L-4	56	18½	13/16	3009-D	6¼	6¼
L-5	42	20½	1½	2589-C	6	6
L-5	42	20½	1½	2589-C	6	6

The manner of calculating the increase in lead and the calculation of the amount of blind to make the back up to maintain at least line and line in full forward gear is shown in the diagrams.

Investigation has developed that it is possible by means of a set of trams to take exact measurements of the length of the eccentric blades and fit up eccentric straps and blades on the floor before assembling, thereby requiring a minimum of skill and work on the part of the valve setter.

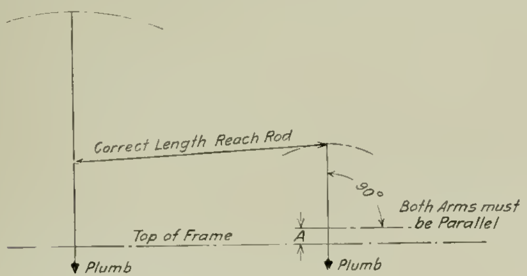


Fig. 7

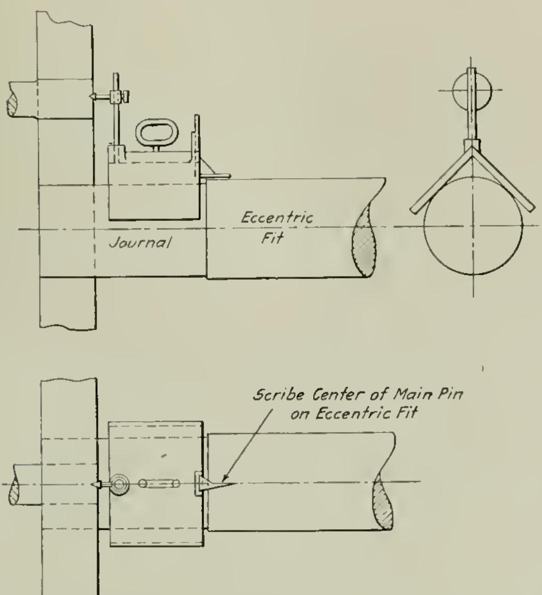


Fig. 8

Setting valves is simply making adjustments for various inaccuracies in the assembling of the locomotive. If all parts had the same relation to each other as called for in the drawings the valves would be set correctly when assembled. Therefore, the more parts that conform to the drawings before starting to set valves, the less adjustment will be necessary to produce the desired results.

First Operation—Prove the length of the valve over the edges of the steam and exhaust ports in the valve chamber by means of a standard gage.

Second Operation—Take port marks in the usual manner.

Third Operation—Prove the length of the reach rod, reverse shaft and rocker arms as in Fig. 7.

Fifth Operation—Locate the eccentrics on the axle before wheeling the engine. First, transfer the center of the main crank pin to the eccentric fit on the axle with a box gage, Fig. 8. Locate eccentric keyways with the standard gage for each class of engine. For engines having slide valves with indirect rocker, see Fig. 9. The gages are to be made in accordance with the following table:

Engine, Class	Gage No.	Lap, in.	Lead, in. F	Lead, in. B	Ecc. fit Z, in.	Distance from pin, in. F. M	Distance from pin, in. B. M.	Ecc. throw, in.
G-1	2	⅞	line and line	⅛ blind	9	5-9/32	5-15/32	2½
G-2	3	1	line and line	..	8	4⅞	4⅞	2½
I-4	4	⅞	line and line	⅛ blind	7¾	4½	4-21/32	2½
I-4 .	4	⅞	line and line	⅛ blind	7¾	4½	4-21/32	2½
I-5	5	⅞	line and line	⅛ blind	8¼	4-25/32	5	2½

Note—Engines not covered by above table to be set line and line.

Fourth Operation—Prove the link and hangers as in Fig. 6.

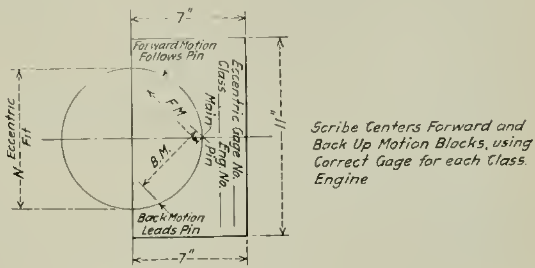


Fig. 9

For engines having piston valves (inside admission) and direct rockers, use gages similar to those described for slide

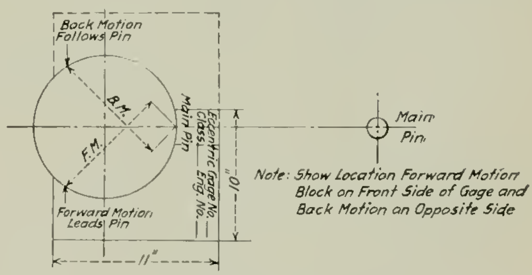


Fig. 10

valves, but made to the dimensions shown in the following table:

Engine, Class	Gage No.	Lap, in.	Lead, in F	Lead, in B	Ecc. fit Z, in.	Distance from pin, in, F. M.	Distance from pin, in, B. M	Ecc. throw, in.
L-2	1-A	1⅛	..	¼ blind	9 5/16	5 3/16	5 9/16	2¼
L-2	1	1⅛	..	¼ blind	9 5/16	5¼	5⅝	2¼
L-4	1	1⅛	..	¼ blind	9 5/16	5¼	5⅝	2¼

For engines having piston valves (inside admission) and indirect rockers, see Fig. 10, the gage to be made in accordance with the following table:

Engine, Class	Gage No.	Lap, in.	Lead, in. F	Lead, in. B	Ecc. fit Z, in.	Distance from pin. in. F. M.	Distance from pin. in. B. M	Ecc. throw, in.
H	6	1⅛	1/16	1/16	9⅞	8¼	8¼	5
L-3	7	1	⅛	⅛	8 13/16	7-7/32	7-7/32	5
L-5	8	1	⅛	⅛	9 5/16	7-23/32	7-23/32	5½
L-5	8	1	⅛	⅛	9 5/16	7-23/32	7-24/32	5½

Sixth Operation—Prove the keyways in the blocks. After locating all keyways correctly on the axle, check the keyways

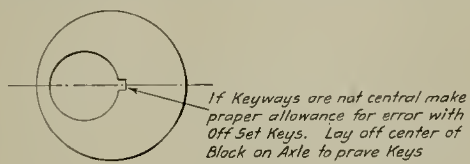


Fig. 11

in the old eccentrics to prove that they are centrally located. See Fig. 11.

Seventh Operation—Approximate length of valve rod. Plumb the rocker arm or transmission hanger and alter the valve rod until the tram is central between port marks as in Fig. 12.

After performing the above operations correctly it is possible to take direct from the engine by a set of five trams,

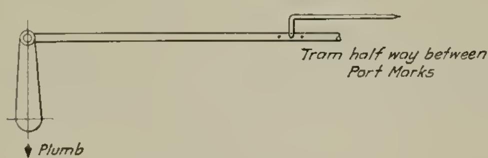


Fig. 12

the correct length of each eccentric blade. After using the proper tram to set the link correctly the following rules must be observed:

(1) Place the engine on the forward dead center for each side separately. This applies to all engines except classes H, L-3 and L-5, having inside admission piston valves, with indirect rocker, which engines are placed on the back dead center.

(2) Place the reverse lever on the center.

(3) Move the valve stem in the direction to open the valve off the central position (found by operation seven)

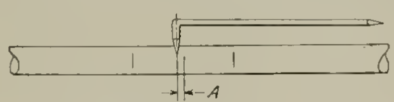


Fig. 13

an amount equal to the increase lead from corner to mid-gear, as shown in operation eight.

Eighth Operation—Move the valve stem toward the lead opening. The amount of lead increases from corner to mid-gear. See Fig. 13.

Engine, Class	A, in.	Direction of A
G-1	5/16	Toward lead
G-2	11/32	Toward lead
H	¼	Toward lead
I-4	5/16	Toward lead
I-5	⅜	Toward lead
L-2	5/16	Toward lead
L-3	3/16	Toward lead
L-4	5/16	Toward lead
L-5	3/16	Toward lead

Ninth Operation—Set the link and clamp it in position to tram the length of the blade. The lever must be on center. See Fig. 14.

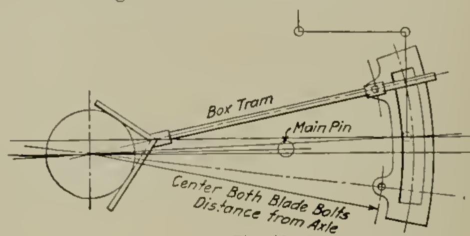


Fig. 14

Tenth Operation—Take the length of each blade separately with the engine on forward dead center for the side on which lengths are being taken. This applies to all engines

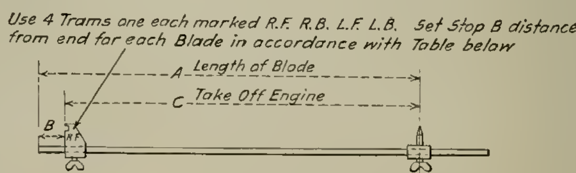


Fig. 15

except class H, L-3 and L-5, which are to be on the back dead center, as in Fig. 15.

Engine, Class	Distance B, in. Forward	Distance B, in. Back
G-1	25/32	21/32
G-2	⅞	⅞
H	1⅛	1⅛
I-4	25/32	11/16
I-5	25/32	11/16
L-2	1	¾
L-3	1	1
L-4	1	¾
L-5	1⅛	1⅛

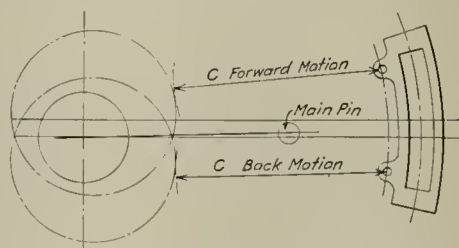


Fig. 16

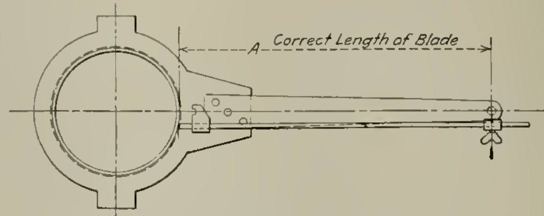


Fig. 17

Eleventh Operation—Take length distance *C* as in Fig. 16.

Twelfth Operation—Assemble the blades and straps to correct length *A* on the floor before applying to the engine. See Fig. 17.

GAGE FOR CHECKING CYLINDER PORTS AND SLIDE VALVES, SEE FIG. 18

Engine, Class	Valve face, in. E	F	G	Cylinder ports, in A	B	C	D	Lap, Steam in.	Clearance, Exhaust in.
G-1......	2-7/32	5 9/16	10	8¼	3	1¼	1⅜	⅞	1/32
G-2......	2-11/32	5 9/16	10¼	8¼	3	1¼	1⅜	1	1/32
I-4.......	2⅛	5½	9¾	8	3	1¼	1¼	⅞	Line and line
I-5	2¼	5½	10	8¼	3	1¼	1⅜	⅞	Line and line

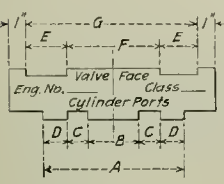


Fig. 18

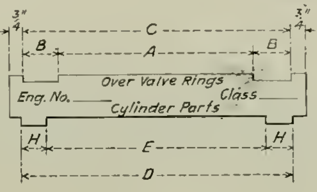


Fig. 19

GAGE FOR CHECKING CYLINDER PORTS AND PISTON VALVES—SEE FIG. 19

Engine, Class	Over valve rings, in. A	B	C	Cylinder ports, in. F	H	D	Lap, Steam, in.	Clearance, Exhaust, in.
L-2...	22½	2-21/32	27-13/16	24¾	1⅝	28	1⅛	3/32
L-3...	19	2½	24	21	1½	24	1	....
L-4...	22½	2-21/32	27-13/16	24¾	1⅝	28	1⅛	3/32
L-5...	16¾	2½	21¾	18¾	1½	27¾	1	....
H.....	22½	2-21/32	27-13/16	24¾	1⅝	28	1⅛	3/32

The amount of increase in lead from full gear to mid-gear is determined by the radius of the link and the distance between blade pins. On all locomotives having open eccentric rods the lead increases when hooked up. On all locomotives having crossed eccentric rods the lead decreases when hooked up and the engine becomes very blind in mid-gear, in some cases as much as 9/16 in. blind. This gear is very undesirable. To overcome this give 5/16 in. lead

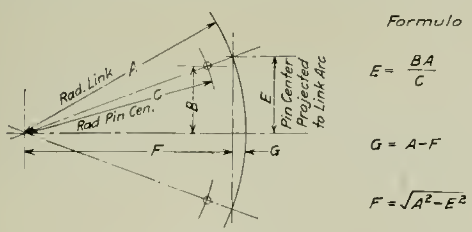


Fig. 20

in the corner and the engine will not go blind until worked at less than half stroke. See Fig. 20.

Open Rods—Lead increases from full gear to mid-gear. This combination is used on all engines having (1) inside admission piston valves and direct rocker or (2) outside admission valves and indirect rocker. See Fig. 21.

Crossed Rods—Lead decreases from full gear to mid-gear. This combination is used on all locomotives having

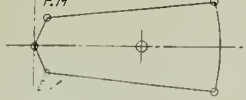


Fig. 21

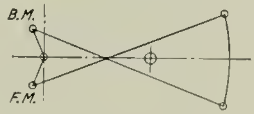


Fig. 22

inside admission piston valves and direct rocker. See Fig. 22.

By using indirect rocker with this combination of rods the lead can be changed from decrease to increase.

Valve Diagrams—After determining the amount the lead increases from full gear to mid-gear, it usually develops that if both forward and back motion blocks are set line and line the lead increases to such an amount that the port opening is so great even with the reverse lever on center that the shortest cut-off possible has been found to be nearly 30 per cent of the stroke. To overcome this defect set the back motion blind enough to reduce the lead to 5/16 in. in mid-gear, as determined by the Zeuner valve diagram.

Example: Valve travel 6¼ in., lead increase 7/16 in.

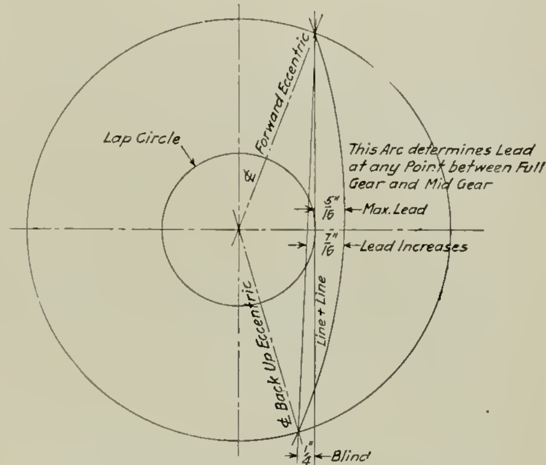


Fig. 23

from line and line, lap 1⅛ in. To find the amount to blind, back up to produce 5/16 in. lead on center with forward motion line and line. See Fig. 23.

For some unknown reason the lead does not increase as it should by using the indirect rocker with crossed rods and it has been found necessary to set one class of Consolidation type with 5/16 in. lead in the corner to have 3/16 in. lead on the center, but this type of construction is very old and only a few such engines are still in existence.

SOUTHERN VALVE GEAR

All locomotives having Southern valve gear are designed for constant lead, and should be so set. It is not possible to set this gear for variable lead and it should never be attempted. By adopting the process of elimination, proving one part at a time, the best results are obtained.

All of the motion to the valve is imparted from the eccentric crank. Since the lap and lead depends on the

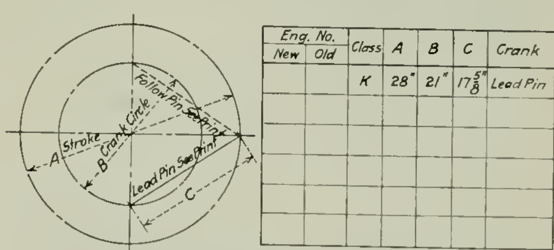


Fig. 24

length of the eccentric rod, the correct length must be maintained. In this gear the center of the main axle is the fixed point and the link must be brought to the proper relation to the main wheel center. The best results can be obtained by following the instructions given below.

First Operation—Set eccentric crank in accordance with the drawings of the gear. See Fig. 24.

Second Operation—Prove the reach rods and links. See Fig. 25.

Third Operation—Square the lead and adjust the valve rod. With the engine on dead centers take lead marks on the valve rod and equalize the lead by altering the valve rod. Have the lever on center when taking the lead marks.

If the above work has been properly performed the reverse lever can be placed in any position with the engine on either dead center and prove constant lead. Squaring the

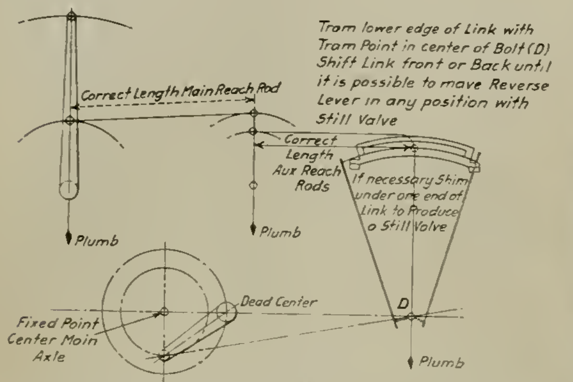


Fig. 25

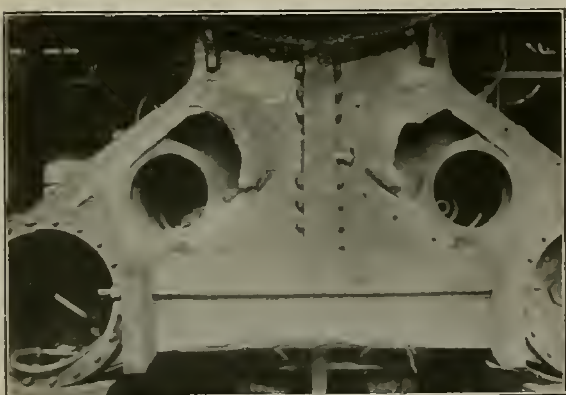
lead is done on the valve rod and automatically takes care of any reasonable error in the vertical location of the link.

A convenient rule is as follows: To square the lead, adjust the valve rod only. To equalize the cut-off adjust the link until a still valve is obtained when the engine is on either dead center and a square cut-off is the result. If over-all cut-off on one side is greater than the other, shorten the auxiliary reach rod ¼ in. for each inch of cut-off it is desired to reduce.

PATCHING PISTON VALVE CYLINDER

An interesting job of welding, performed in the repairing of a pair of piston valve cylinders, was recently done at the Stony Island shop of the New York, Chicago & St. Louis.

The broken parts of the cylinders were first drilled and chipped off flush with the main body of the casting, forming a smooth surface. Two flanged patches, as shown in



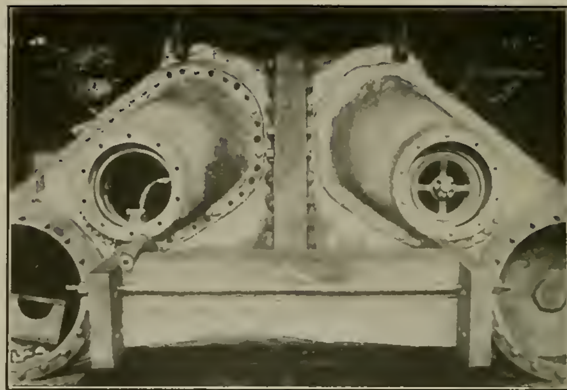
The Broken Cylinder as Received in the Shop

the sketch, were formed of ½-in. boiler plate and a ½-in. by 5-in. by 5-in. angle. The boiler plate extended to the center line of the piston valve cylinder, as shown, and the back half of the circle was formed of the ½-in. angle, the two parts of the patch being welded together with acetylene. The holes for the valve chamber were then cut out with an acetylene torch.

A ring was shaped from ¾-in. steel plate and faced and welded to the main patch, forming the valve chamber head joint and the body for the cylinder head studs.

Four holes were punched in the patch, the patch put on the cylinder, and the flange heated and set up with a flatter. After the patch was properly shaped the holes were drilled in the flanges, on 2½-in. centers, the patch again applied and reset. The patch was then taken off and put on a boring mill and the joint faced and the hole bored to admit the valve.

The patch was then reapplied to the cylinder with a



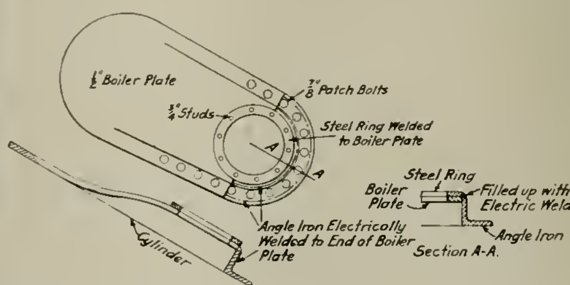
The Cylinder Casting with Patches Applied

1/16-in. copper gasket and patch bolts put in and set as the work progressed. The patch bolts being applied, the edges of the patch and the heads of the bolts were caulked and the job was complete.

The cost of the material and labor for the repairs to this cylinder were as given below:

LABOR		
Erecting shop	$251.04	
Boiler shop	129.32	
Tin shop (gasket)	.68	
Total for labor		$381.04
MATERIAL		
300 lb. ½-in. by 36 in. by 96-in. steel	$10.19	
76 ⅞-in. patch bolts	8.29	
20 ¾-in. by 3-in. studs	1.20	
11 lb. 1/16-in. copper	.24	
3 ft. 5-in. by 5-in. by ½-in. angle iron	1.70	
Total for material		21.62
Total for application of the two patches		$402.66

This method of repairing proved effective and permitted



Construction of Patch for Piston Valve Cylinder

the reclamation of these cylinder castings without the necessity of removing them from the locomotive, thus considerably reducing the length of time the locomotive was out of service.

The Casehardening of Steel

Methods Employed; Their Effects, Proper Packing and Control of Temperature Are Important Factors

BY J. F. SPRINGER

THE casehardening of steel is quite an old process, but it is, nevertheless, one of great usefulness, both from a technical and an economic standpoint. It can not be said, however, that it is a thoroughly understood process; nor that the practitioners are everywhere succeeding uniformly in getting the best possible results. In the United States the problem does not seem to have had from our best technical men the attention it deserves nor even the attention given to certain other subjects of no greater industrial importance.

Casehardening is a process of impregnating the exterior layer of low-carbon steel with a high percentage of carbon, thereby making it possible to harden this external layer and leave the interior soft. It is an exceedingly valuable result when adequately achieved.

It is frequently of very great importance to get a thorough understanding of what is *not* wanted, as this greatly assists in getting the results actually desired. The regulation procedure in casehardening is briefly as follows: The articles to be treated are packed in boxes or cases in a packing material competent to supply carbon, such as bone dust, charred leather or the like. The box is sealed and the whole then heated to a fairly high temperature and maintained at this temperature for a considerable period. The heat causes the packing to give off carbon and the metal to absorb it. The impregnation which takes place involves first the external shell or case of the various articles. There is no great difficulty in getting this general result, nor in carrying it to the point that the impregnated shell is moderately thick and possesses a high local percentage of carbon. It is, however, difficult to avoid one or more of the following results, undesirable in the best work:

(1) The zone or shell of high carbon percentage may be very sharply defined from the soft interior. Upon giving the hardening treatment, a shell of very hard steel inclosing a core of soft metal is the result. There is a sudden change from the very hard to the soft. The effects of concentrated shocks on the exterior are accordingly localized upon the soft interior. This means that the interior is unable to present the resistance of which it is really capable, because of the lack of distribution of the shock. The exterior shell being thin and brittle is, accordingly, liable to break.

(2) The highly carbonized shell may vary in thickness. This is undesirable because it means regions of unequal resistance to externally applied wearing pressures. If a shell of 1/32 in. thickness is sought as the thing really desired, then spots only 1/64 in. thick will not be desirable.

(3) The external shell when heated and quenched may prove insufficiently hard. This is a serious matter. Hardness is wanted frequently, not to say generally, for the purpose of resisting the abrasive action of wear and tear. As this resistance is fairly proportional to the degree of hardness, a falling off in hardness is not wanted.

(4) The depth of the hardening effect may be insufficient. This means that the shell of high impregnation is not thick enough. The external hardness desired may be fully attained; but the life of the article in actual service may be greatly shortened because the resistance to wear is gone long before the depth of wear really permissible in the part is reached.

(5) The hardness developed may be found to vary in different regions. This will often be a highly objectionable result. In a machine, it is not desirable that a part should wear unevenly as uneven wear generally means distortion.

(6) Finally, the interior may have lost in physical qualities. Such loss is due to the overheating necessarily a part of the casehardening procedure. This is a very serious matter, probably appreciated by a comparative few. It is, nevertheless, a fact that steel heated above a medium cherry red (1,274 deg. F.) is subject to enlargement of its crystals. This enlargement increases as the temperature is carried further. It is pretty well established that enlarged grains mean reduced physical strength—particularly tensile strength—and that this reduction varies with the overheating beyond medium cherry red. The casehardening temperatures are all above this level, so that the interior of any casehardened article is probably more or less damaged in quality when it comes from the furnace.

In general, what is desired is casehardened articles not subject to any one of these defects. I call attention to one or two of these by way of emphasis. The same degree of hardness over the whole region is manifestly dependent upon the evenness of carburization. Anything in the technique on the materials that will tend to produce regional differences of impregnation are the things to discover and provide against. This should not be confused with variation in depth of penetration. Again, the gradual shading off in the degree of carburization is highly important. It is probably the only thing that will serve to distribute the effects of concentration of shocks from the outside. Finally, the need to restore, as far as possible, the damaged steel of the interior is perhaps the least appreciated.

THE BOXES

The boxes or cases used to hold the work and the packing material during carburization and to retain the carbon and thus force impregnation can not be made from any and all materials, if economy in the cost of such boxes is to be kept in view. Two materials are generally approved—cast steel and sheet steel. Usually, the cast steel box will outlive the one of sheet steel, the conditions being the same. A rough estimate would give the cast box a life from 25 to 30 per cent longer. "Life" is not to be understood as measured by the total elapsed time, but by the number of operations. Under very good conditions the cast steel box may be used anywhere from 15 to 20 times, but the life of the box depends on a number of things—the temperature of carburization, the period of high heat, the strength of the oxidizing atmosphere in the furnace, the mechanical treatment, etc. A furnace having a reducing atmosphere—such as these burning heavy oil—will serve to prolong the life of the boxes. The first cost of the cast steel box will probably be greater, and this will be more or less of an offset to the longer life. The weight of this box will also be greater, which is a disadvantage.

If cast steel is employed, the box should be cast of soft steel. The lid may be of the same material or it may be of sheet metal. For a cast steel box 12 in. by 14 in. by 24 in. in size, wall thickness of 4/5 in. or 1 in. will be proper. If sheet steel is selected, the carbon percentage should be low. The wall thickness for a box of the foregoing dimensions may properly be 2/5-in. or 3/5-in. The seams may be gas or electrically welded.

The size of the box is important. In general, for miscellaneous work the size already given may be considered suitable. Dimensions much exceeding those given should be considered well before they are adopted. The cubic contents should be limited to two cubic feet, or in exceptional cases to three cubic feet, as large boxes generally mean that the heat penetration will be slow. The following objections to such boxes have been expressed: (1) Considerable deformation of the pieces constituting the work, this deformation arising from the inequality of temperature at different points in the box; (2) considerable irregularity in the impregnation, due to the same cause, and (3) the excessive time period necessary to get results. When very large pieces are to be treated the fixed heating compartment may be used. Quite small boxes are desirable, if the work permits. Thus, a box 12 in. by 10 in. by 10. in. is a good one for small, miscellaneous work. Homogeneous impregnation is promoted by the cylindrical box, but this type does not lend itself so readily to handling. This point needs to be considered, as much of the handling is done while the workman is exposed to the heat.

The inside dimensions of a box should be such that the work may be placed in it in such a position that there is no less distance than 1¼ in. or 1½ in. between the work and box at any point.

The cover may, for the box made of either approved material, be of cast iron, cast steel or sheet steel. In all cases, however, the joint is to be such that a good closure may be effected. The cover may fit over the sides of the box.

CHARGING THE BOXES

The bottom of the box is coated with a paste made from clay and water. This should be done some considerable time before the work is to be put in, as it is necessary to wait for the paste to dry thoroughly before taking the next step. The packing material is then put in until a layer, when compressed, is 1½ in. thick. The condition of the packing material is of importance. It should be very dry and well pulverized. If the work consists of rather small pieces, a layer, one article thick, may be arranged. The intervals between articles is nowhere to be less than 1 or 1¼ in. A similar rule applies to the intervals between the walls of the box and the sides of the work, whether the work be large or small. The large single article or the layer of small articles is now packed tightly with the packing material, until the latter is at the highest level of the work. Then a layer of packing not less than 1½ in. thick is packed in tight.

The object in allowing generous intervals between metal surfaces is to guard against actual contact and to provide an adequate amount of material to supply the required carbon. If the final layer of packing will not, when 1½ in. thick, completely fill the box, enough is to be put in to do so. The cover is now put on and the joint sealed everywhere with a paste or mortar made by mixing fire-clay and water.

The whole is now ready for the furnace, except for the possible presence inside of moisture and for the wetness of the seal. However, the box may be put into the heating compartment and left near the door or in some other comparatively cool spot until one is satisfied that all water, especially inside, has escaped.

THE PACKING MATERIAL

The character and condition of the packing material are exceedingly important, not to say vital. There has probably been a good deal of nonsense promulgated in extolling the virtues of complicated preparations. Nevertheless, a good deal of success no doubt has attended the use of some mixtures of this character. But why use complicated mixtures when comparatively simple ones will give equal results? Of course, we should all elect to be "from Missouri" and stand willing to be convinced by actual test.

The packing must contain carbon in some form, otherwise there will result no impregnation with carbon. Various varieties of wood charcoal, such as oak and beech charcoals, are suitable for packing. Charcoal made from leather, or horn, soot, barium carbonate, coke, etc., have all been used as sources of carbon.

But the packing should have certain physical properties as well as possess a carbon content. There should, for example, be more or less porosity to permit the gases to get through. Then there should exist a capability to maintain its volume despite the heat and the escape of gases from its substance. Otherwise, the work might settle unevenly and so suffer deformation. Again, it should be a fair conductor of heat. If not, then there may be great differences of temperature in the interior of the box, the center being much cooler than points near the surfaces of the box. It is also considered advantageous if the packing consolidates well and is at no time of a dusty character. Both these qualities may at times be imparted to packing which lack them but are otherwise suitable. Thick oil may be mixed with the material. The specifications as to heat conductivity and porosity are more or less incompatible, so that a compromise may often be necessary.

Uniformity of action is something to be prized. Simple mixtures are probably the best from this point of view, especially if they tend to retain the gases which they produce until a red heat has been attained—that is, a temperature of some 1,200 deg. F. Vegetable or animal charcoal alone meets this requirement very well. However, wood and bone charcoals do not act to the best advantage through the earlier part of the carburizing range. They may be stimulated to activity by the addition of an alkaline carbonate. Barium carbonate and sodium carbonate—both low-priced chemicals—are advantageous additions to wood charcoal. As between beech and oak charcoals on one hand, and charcoals from other woods, the former are probably better than the latter; but the mode of making the charcoal is of greater importance than the precise kind of wood.

The use of barium carbonate with wood charcoal tends to produce a coloring effect upon the work. That is, the work is apt to come out covered with a thin layer or deposit of graphite. This tendency, if objected to, may be corrected by the addition of 10 per cent of saw dust to the mixture, W. H. Dyson being authority for this statement. It is thought that the deposit is due to the contact with the work of carbon monoxide (CO) which has been liberated at temperatures below 1,475 deg. F. In actual practice, however, the undesirable temperatures ought to be passed in a short time. The deposit ought then to be rather a thin one, if it is present at all. If trouble is experienced, the saw dust remedy may, of course, be readily applied.

Granulated bone is the usual material employed in the United States. It gives satisfactory results in many cases, but it seems to possess an objectionable characteristic when used for a prolonged period at a high temperature. As the extended period and the elevated temperature may be needed to get certain results, it will be of advantage to consider this matter further. If bone is ignited and burnt, the ash, amounting perhaps to anything from 50 to 80 per cent of the weight of the original charcoal, will be found to consist principally of calcium phosphate. In a carburizing box, under the influence of the heated metal and charcoal, a reduction of calcium phosphate may take place. This would mean the liberation of phosphorus, which may then combine with the iron of the soft steel, and phosphide of iron would be the result. This substance is brittle and melts at a low point. Forming on the surface of a casehardened object, it will at times produce a roughening of that surface, or a blister may be formed. In an actual case, splinters were secured and tested. Phosphorus to the amount of 2½ per cent was found to be present. There was also reason to think that the carburizing temperature had reached 1,800 deg. F., or some higher level.

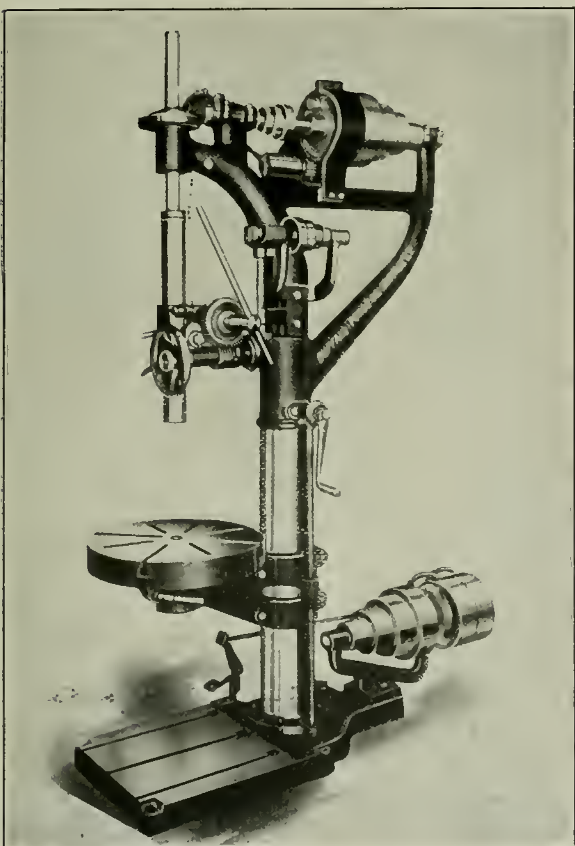
(To be continued.)

NEW DEVICES

A BACK GEARED UPRIGHT POWER DRILL

The Buffalo Forge Company, Buffalo, N. Y., is making a 25-in. back geared upright power drill as shown in the illustration. This machine has a 21-in. diameter table and a spindle travel of 14½ in. It has eight speeds, four power feeds and a hand lever feed. The handle is adjustable from 6 to 18 in. and is held in place by a tension spring. The worm feed wheel runs in oil and is latch-hinged to take up wear.

The mechanism can be thrown from plain to back geared drive without using a wrench. This is done by disengaging a knurled knob in the top gear and throwing in the back gears by means of the hand lever, and it is held in place by a locking screw.



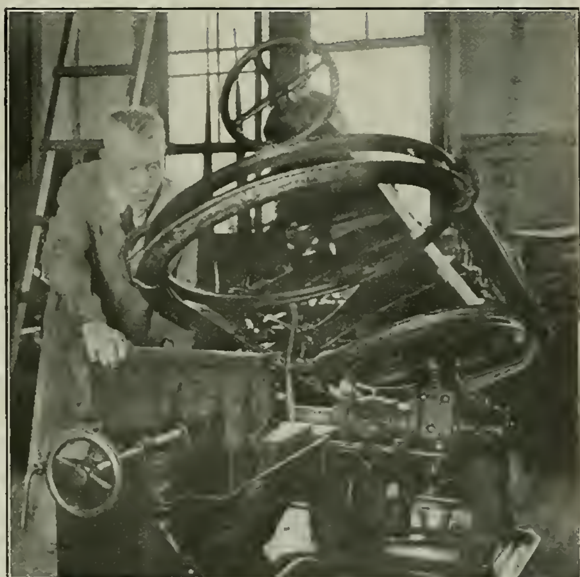
The Buffalo Upright Power Drill

Adjustable split bearings are provided for all shafts and ball thrust bearings are used where necessary. This machine is designed for accurate work and an automatic trip throws out the power feed instantly when the piece has been drilled to the required depth.

GRAVITY FEED BAND SAW

The idea of a continuous stroke hack saw has been embodied in the band saw machine, developed by the Napier Saw Works, Inc., Springfield, Mass.

The saw blade feeds into the work by gravity, due to the balanced weight of the tilting head. A spring at the back of the machine is in such a position and of such tension that the feeding weight is constant from start to finish of any cut which can be made on the machine. The gravity feed feature of this machine is a rather distinct departure from any other type of feed used for this work. When in operation the gravity feed does not force the saw band into the metal beyond the band's capacity to withstand the strain. When tough and hard metal is being cut, the feed is just heavy enough so that the teeth of the band take hold and this feed is constant as long as the uniformity of the steel remains constant. Should a softer metal be cut, the feed is heavier and better time is made.



Napier Band Saw Cutting Heavy Rail Section

The base of the machine is of cabinet type with lubricating tank enclosed. All bearings are large and those in clutch pulley and in the driving and idle wheels, which carry the tension of the saw, are extra heavy and rigid to withstand the strain.

The cutting band is lower than the returning band, as shown in the illustration, thus making it possible to cut off any length required. The cutting band is supported by truss arms, each carrying a pair of specially designed guides.

By means of the rolling guides the band saw is directed so that its vertical travel between the truss arms is in perfect alignment, thus assuring a straight cut. These guides once set are in perfect adjustment for any saw that may be placed in the machine.

A rotary pump of simple design provides ample cutting compound for the saw. The teeth of the band saw are downward in the cut, which insures that the cutting compound flows at once to the point of the saw tooth where it is needed. The capacity of the machine is greatly increased by this ample flow of cutting compound.

An important advantage of this type of machine is the saving in metal due to taking a narrow cut. For most kinds of work the band saw blade thickness is less than .049 in. while a circular saw would be 3/16 in. thick or more. In other words, when cutting up expensive material, an appreciable saving results from the use of a band saw with a thin blade.

The following is a table of specifications and of speeds recommended:

Floor space	4 ft. by 6 ft.
Height, floor to table	26¾ in.
Length, band saw	12 ft. 3 in.
Size of band saw	1 in. by .035
Net weight	1,700 lb.

Speeds

Soft steel, 120 lin. ft. per min. of band saw; 80 rev. of driving pulley.
Tool steel, 100 lin. ft per min. of band saw; 70 rev. of driving pulley.
Soft metals, 150 lin. ft. per min. of band saw; 100 rev. of driving pulley

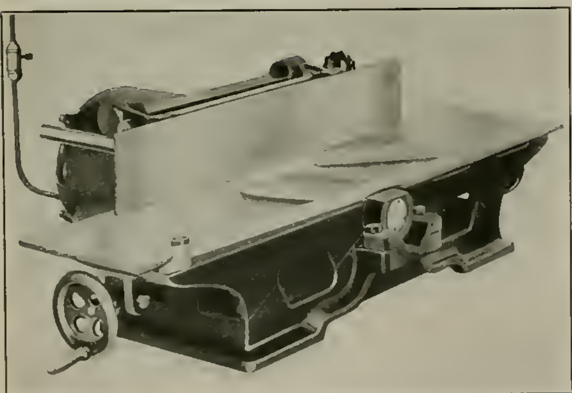
Power required	1 bp.
Geared	4 to 1
Driving pulley	12 in. by 3 in.

THE WALLACE BENCH JOINTER

A portable six-inch, motor-driven bench type of jointer has been developed and is being marketed by J. D. Wallace & Co., Chicago.

This machine was designed to place in the shop at points convenient to the workmen, thus eliminating the loss of time due to walking to and from the stationary machines. It can easily be carried by one man and thus practically becomes part of an individual tool kit.

An especially interesting feature is a new fence that has been developed in connection with this machine. This fence is mounted on the motor and slides backward or forward on rods, rendering it more quickly and accurately adjustable than any ordinary machine. The fence is designed so that only a fraction of an inch is lost on the table when the fence is set for beveling.



Side View of the Jointer Showing Adjustable Front and Rear Tables and Safety Guards

The cutter head can easily be taken out and other heads inserted in a few seconds. The tables are arranged to slide backward to permit the use of these special heads, or forward so as to work with the narrowest possible throat opening, a feature that will prove especially desirable when the machine is doing small or very close work.

Ball bearings are used on all motor and cutter head bearings, thus eliminating friction and prolonging the life of the machine.

An ingenious and apparently very efficient arrangement of the flap and shutter guard has been effected by mounting the shutter guard on the cutter head bearing rather than in grooves.

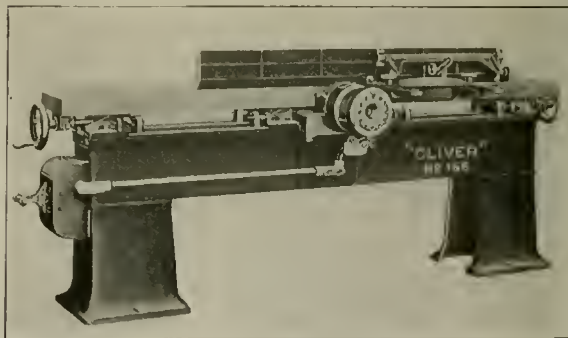
Each machine is equipped with a motor, lamp cord and plug for connection to the ordinary lighting circuit.

OLIVER HAND PLANER AND JOINTER

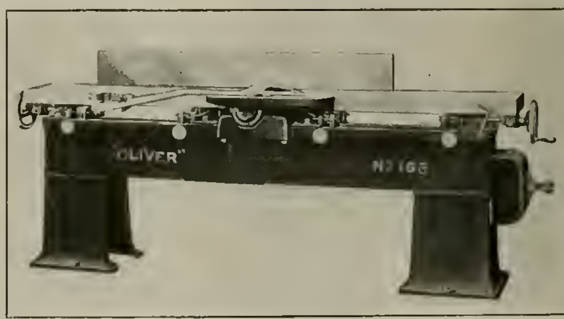
The Oliver Machinery Company, Grand Rapids, Mich., have placed on the market a new motor-driven hand planer and jointer.

As shown in the illustrations, this machine is provided with a self-contained direct mounted motor drive. A 3,600-r.p.m., three-phase, 60-cycle, 220-volt A. C. motor and a three-knife cylinder are used.

On the outer end of the cylinders, where the pulley usually is mounted. the cylinder is shaped to receive the rotor of the motor. On the outside of this rotor and concentric with it is the stator of the motor, held by means of the adapter and the outer end cover. The direct mounted motor drive runs in extra large ball bearings which insures long life to the bearing and smooth operation of the motor.



Rear View of the Hand Planer and Jointer Showing how the Motor is Mounted



Front View of the Hand Planer and Jointer

This hand planer and jointer is adapted to a wide range of work and the drive is suitable where three-phase, 60-cycle, . 220-volt electric current is available.

A CONVERTIBLE STOCK CAR

A DEVICE DESIGNED to convert the ordinary live stock car into a box car for general merchandise purposes has been placed on the market by the U. S. Convertible Car Company of Fort Worth, Texas.

This equipment consists of moveable floors of 2-in. pine and steel folding side walls, which are hinged to the moveable floor and to the inside of the car near the roof. As shown in the illustrations the moveable sides and floor are operated by means of ratchet cranks attached to a worm and sector device located under the car and connected to the moveable floor at each corner by a ⅜-in. steel cable moving over sheaves located inside of the car.

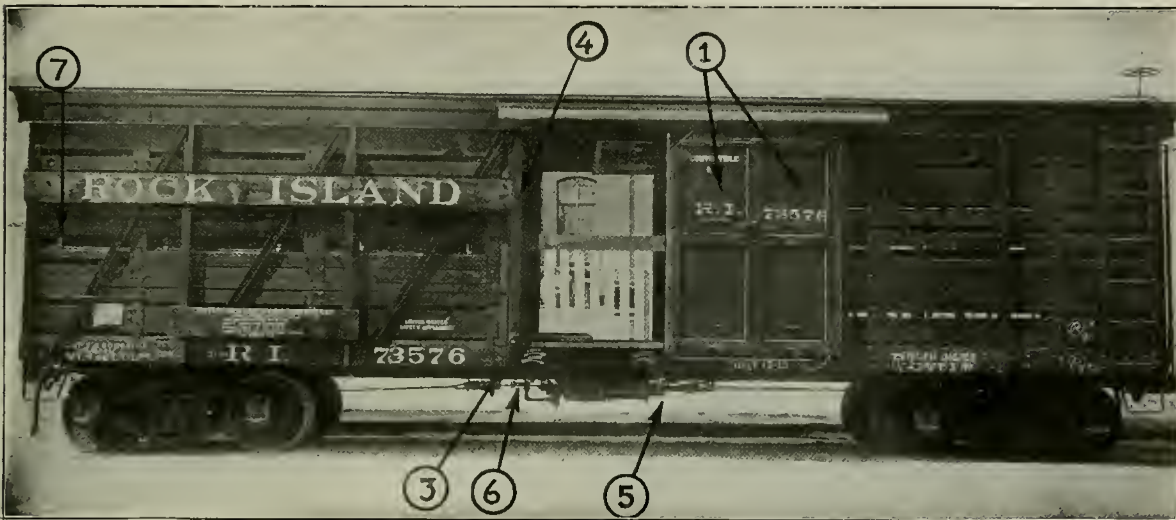


Fig. 1—A Rock Island Stock Car Equipped With the Convertible Device.

An old stock car to which this device has been applied is shown in Fig. 1. The water-tight live stock door 1, with the protector or water seal 4, is part of the necessary equipment, although not an integral part of the convertible device. The worm and sector 3, the ratchet cranks 5 and 6, and the side lock bolts are located as shown. This car operated successfully for a period of more than a year.

Fig. 2—One End of Car Arranged for Merchandise. (1) Safety Lock; (2) Movable Floor; (3) Showing Absence of Any Nails or projections to Injure Live Stock; (4) Instructions for Operating Device; (5) Door water Seal; (6) Provision for Fastening Grain Doors.

In Fig. 2 the car is shown with one end having the convertible device raised to the top of the car as when live stock is carried, and the other end with the device in place as when the car is used for general merchandise or grain.

The manner in which the device operates is clearly shown in Fig. 3, which shows the folding side walls 6 and 7 as they automatically unfold, as the moveable floor 8 is lowered into position on top of the permanent live stock floor 10. In the foreground of Fig. 3 the merchandise, or moveable, floor 8 is lowered down on top of the live stock floor 10 by operating the ratchet crank. The cable 4 running over the sheave 5 lowers the floor and the side walls unfold, the slot hinge 1 and 2, secured by the U-bolt 3, permitting the movement without any binding. The side walls are then secured against the slatted sides 11 of the car by the side lock bolts which are secured in place by the lock bolt button 13.

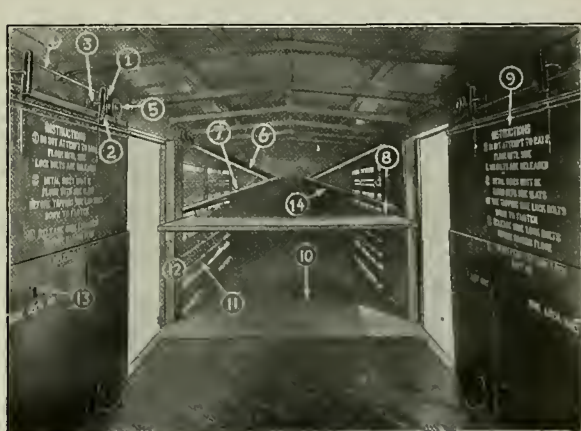


Fig. 3—One End of Car Ready for Merchandise and Convertible Device Lowering Into Position in the Other End.

The general appearance of the interior of the car when arranged for merchandise is shown in Fig. 4. This shows the clean merchandise floor 2 in place on top of the live stock floor and the ventilated door 3 closed for merchandise loading. An end door 1 is provided so that live stock can be given necessary attention. The ends of the steel folding side walls are crimped so that the door jamb 4 is exposed to permit the application of a grain door. With the addition of a grain door this arrangement can also be used for the transportation of grain.

There are a number of advantages to be gained by the use of this device. The transportation of live stock necessitates a type of car for which it has been impossible to find freight, of a kind that can be handled in them, in sufficient quantities to load in the cars on their return trip to the stock raising sections of the country. This results in an immense

Fig. 4—Interior of Car as Arranged for General Merchandise.

loss due to non-revenue or empty car-miles. As there are long periods when there is no live stock business these cars must frequently lie idle, and it is estimated that the average time in service of such cars is only from 25 to 40 per cent.

This convertible appliance makes it possible to keep stock cars in practically continuous service, and the operation of the device is so simple that a station agent or any other person can convert from one type of car to another without any assistance from the mechanical department.

FORGED-CUTTER TOOL HOLDER

A new line of tool holders known as the Vulcan Forged-Cutter tool holders has been placed on the market by J. H. Williams & Co., Brooklyn, N. Y. As the name implies, these holders are drop forged of special steel and with their inserted cutters are adapted to the heaviest service in any regular machining operation on the lathe, planer or shaper.

Williams Forged-Cutter Tool Holder

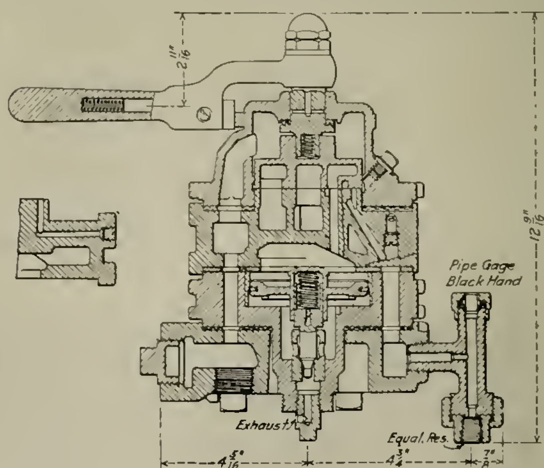
The main advantages of this type of tool are its low cost due to the small amount of high speed steel used, and the fact that by maintaining an ample stock of cutters for all regular needs, the machine operator can give his entire attention to the turning out of work and is insured against interruption due to dull or broken tools.

Referring to the illustration, the construction of the Vulcan tool holder is shown in phantom. The angular seat on the rear of the shoulder in the small figure permits the locking pin to force the heel or step of the shoulder directly against the holder proper. This method of locking provides the necessary bearing to support the cutter pressure and prevents all rocking movement of the cutter itself.

The holders are all drop-forged from a special steel, so treated as to develop its maximum toughness and stiffness. The cutters, extra heavy in design, are drop-forged from high speed steel and are finished and hardened ready for use. They are furnished in a variety of sizes and shapes, such as side, diamond point, roughing, hog nose, flat nose or threading.

COLLAPSIBLE EQUALIZING PISTON FOR H-6 AUTOMATIC BRAKE VALVE

A collapsible equalizing piston incorporated in the H-6 automatic brake valve is an innovation recently introduced by the Westinghouse Air Brake Company, Wilmerding, Pa. The device has proved of material benefit in overcoming a prevalent undesirable condition in passenger service of overcharging the equalizing reservoir. This condition is brought about on account of the increased length of trains, brake pipe volume, main reservoir pressures and high differentials of pressures, which require a close fitting piston. The collapsible feature insures equality of brake pipe and equalizing reservoir pressure without which brake manipulation is in-



Cross Section of H-6 Brake Valve with Collapsible Equalizing Piston

terfered with more or less when making the second application of a two application stop. The collapsible equalizing piston accomplishes its purpose more completely than does the solid equalizing piston as with this feature it is possible at any time during the release of the brake to move the brake valve handle to application position and secure an immediate response of the brakes.

In construction the collapsible type of equalizing piston, as shown in the illustration, consists of the piston and its stem held in normal relative position by a spring in the hollow sleeve in which the equalizing discharge valve proper slides. Whenever the equalizing reservoir pressure is raised slightly higher than brake pipe pressure, as usually occurs when releasing a train of any length owing to the small volume of the equalizing reservoir, as compared with the brake pipe and auxiliary and supplementary reservoirs, the excess pressure on the top of the equalizing piston compresses the spring and forces the equalizing piston down to a position in which the by-pass grooves in its bushing are uncovered, thereby permitting the pressure in the equalizing reservoir and brake pipe to equalize.

The collapsible equalizing piston is furnished as a part of the H-6 brake valve when so ordered, or can be supplied as a separate or repair part for brake valves already equipped with a solid piston. The only modification required in the brake valve, when substituting the collapsible piston for the solid piston, consists in cutting four by-pass grooves .044 in. deep by .088 in. wide by ½ in. long in the bottom of the equalizing piston bushing and equally spaced around the bushing.

DETACHABLE AIR DRILL

In the new air drill recently placed on the market by the Duntley-Dayton Company, Chicago, there is a unique departure from standard air drill construction. The motor

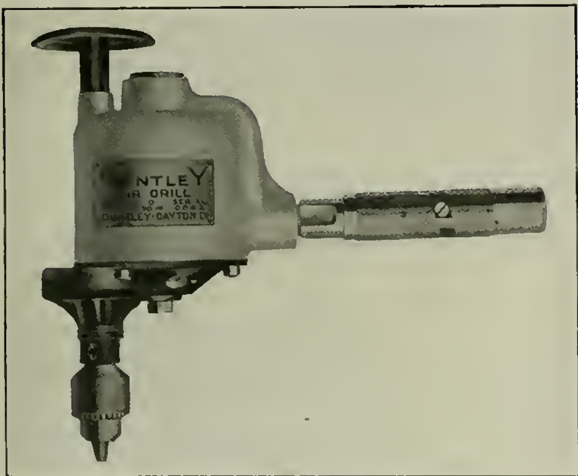


Fig. 1—Duntley Air Drill

or power unit is quickly detachable, thus making it possible by the removal of three screws and a nut, to replace or repair the motor should this become necessary. Two of the screws

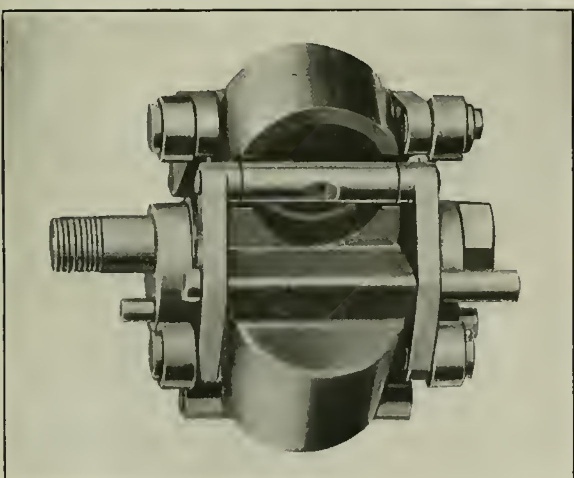


Fig. 2—Self Contained Air Motor

and the nut are shown in Fig. 1 which is a general view of the drill.

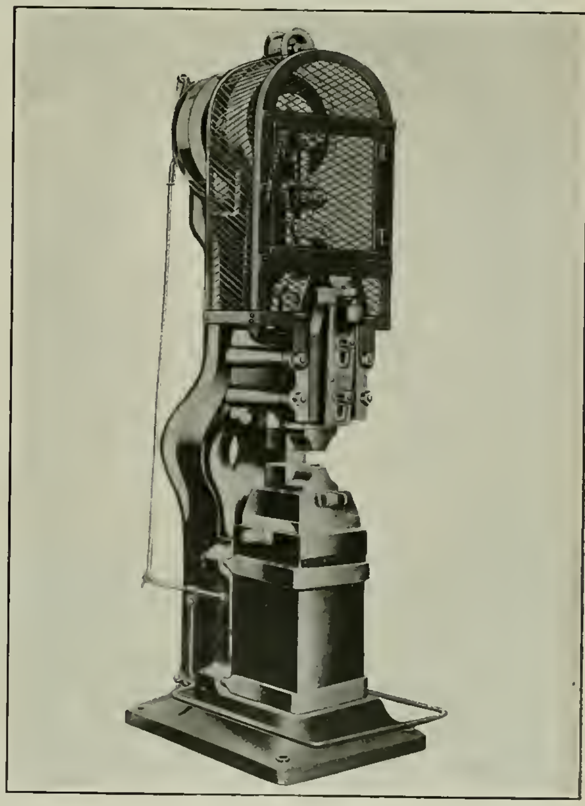
Up to the present time two sizes of breast drill have been manufactured with capacities up to ¼ in. and ⅜ in. These drills are especially adapted for drilling tell-tale holes in staybolts, and work of that character. As the motor is self-contained and well balanced, there is practically no vibration, a desirable feature in the performance of accurate work. The drill weighs only 4-½ lb.

The self-contained motor shown in Fig. 2 consists of three cylinders and pistons mounted in a frame, the entire engine rotating about a fixed crankshaft or spindle. The cylinders oscillate from a fixed base and cams on the spindle operate the valves. All working parts run in a bath of oil.

It is claimed that the Duntley air drill due to economical air consumption and lack of vibration can be used to good advantage on work hitherto performed almost exclusively by electric drills.

FAIRBANKS POWER HAMMER GUARD

To provide full protection to operators of this machine, the United Hammer Company, Boston, Mass., has designed a guard for its Fairbanks power hammer, which completely covers the working parts of the machine. The guard is made



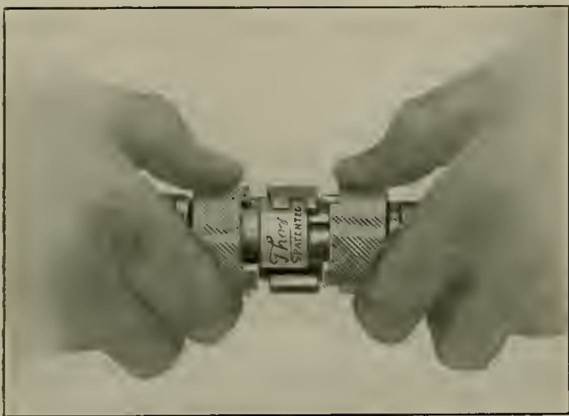
Safety Guard for Power Hammer

of woven wire stretched across a metallic frame work which fits the upper part of the machine.

By means of a door shown in the illustration, the parts are easily accessible as before, for the purpose of oiling and adjusting. The safety guard interferes in no way with the operator and is easily attached to Fairbanks hammers already in operation. It may also be applied to the new 400-lb. and 500-lb. hammers recently developed for locomotive and other heavy classes of work.

A QUICK OPERATING HOSE COUPLING

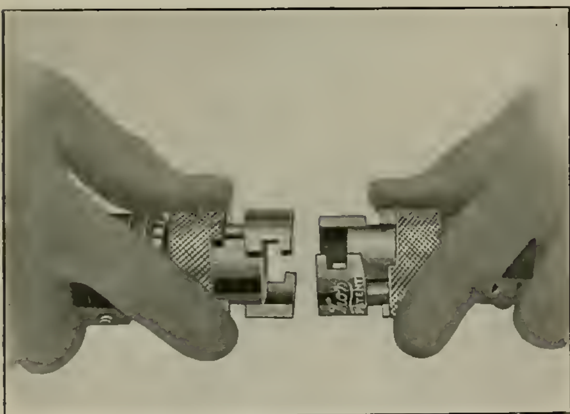
A new hose coupling with several important advantages has been placed on the market by the Independent Pneumatic Tool Company, Chicago, and is known as the New Thor Perfect Hose coupling. Its particular advantage lies in the fact that it may be disconnected instantly by a straight pull on the knurled sliding sleeves. These sleeves are plainly shown in the illustration and when they are pulled



New Thor Perfect Hose Coupling with Sleeves Pulled Back Ready to Disconnect

back the coupling ends may be disconnected without unscrewing or even twisting, as is necessary with many hose couplings. The jaws separate as soon as the locking shoulder moves back.

The beveled jaws and locking shoulders are heavy with large bearing surfaces and cannot easily bend, break, or work loose. The operating spring is large and durable, but can be easily replaced if necessary by removing the washer. An L-shaped gasket is held in place by the air pressure when the coupling is connected. It cannot be blown out when the coupling is disconnected, because of the beveled



Hose Coupling Disconnected

face on the gasket and protecting shoulder in the coupling. Gaskets are interchangeable in ⅜-in., ½-in. and ¾-in. sizes and those in the 1-in. and 1¼-in. sizes are interchangeable. The New Thor Perfect hose couplings are interchangeable between the various sizes and combinations up to ¾-in. inclusive. Each hose end is identical with the other, making a universal coupling which requires no reducers.

THE SILVER RADIAL DRILL

A radial drilling machine of well balanced design and embodying several new features, has been placed on the market recently by the Silver Manufacturing Company, Salem, Ohio. The base of this machine is strongly ribbed both lengthwise and crosswise, and the T-slots are accurately planed, ample allowance of metal being left to prevent springing. The column is of semi-steel, ground to size, the inner column or post being reinforced by heavy ribs running nearly the entire length. The outer column telescopes the post and rests on a ball thrust bearing, making the swinging of the arm extremely easy and also taking the thrust load. The arm, which is of pipe section design, has a wide bearing on the column and is heavily ribbed to resist torsional and bending strains. It is raised and lowered by power and is provided with an automatic "knock out" at both limits of travel.

The arm is firmly clamped to the column by two conveniently located levers, the bolts of which serve a three-fold purpose. As shown in Fig. 1, these bolts act as limit screws to prevent sagging and also as binders. In addition to this, when the levers are placed in the clamping position they

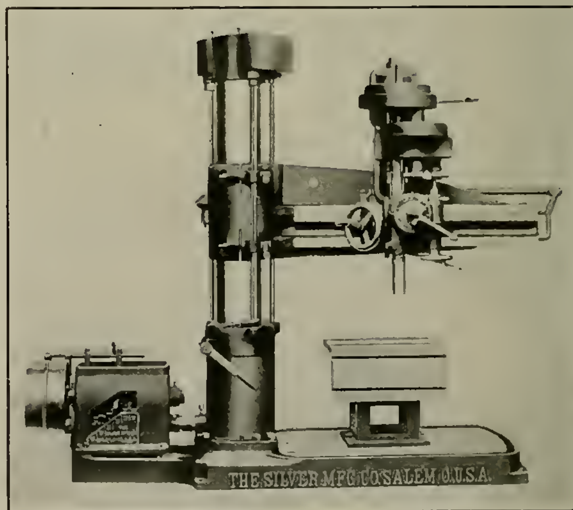


Fig 1—Silver Radical Drilling Machine

tighten the split hub through which the elevating controller shaft runs, which prevents the elevating screw from being set in motion while the arm is clamped to the column. This avoids any danger of wrecking the machine.

Another feature is the safety nut shown in Fig. 2. The purpose of this nut is to prevent the arm from dropping when the threads become worn in the elevating nut. The safety nut runs idle with ⅛-in. clearance between it and the arm, and when the threads wear out in the elevating nut, the load is transferred to the safety nut, which brings it flush with the arm, thus warning the operator in ample time to make replacement and avoid serious accident. The safety nut also provides for continuous use of the machine while the elevating nut is being replaced.

The head is arranged for rapid travel along the arm and contains a two-speed back gearing that may be shifted while running. The spindle is accurately ground to size and double splined. The rack is cut directly on the sleeve, insuring a wide bearing for the hardened rack pinion. Eight feed changes are provided, any one of which may be obtained while drilling by two conveniently located T-handles, which are plainly indexed. Other advantages are a depth gage, automatic feed trip and tapping attachment. Six speed changes are available, which, with back gears on the head, provide 12 speeds in all. All gears in the speed box run in an oil bath.

The silver radial drill is manufactured in three sizes—2½-ft., 3-ft. and 3½-ft.—and it drills to the center of 5-ft.

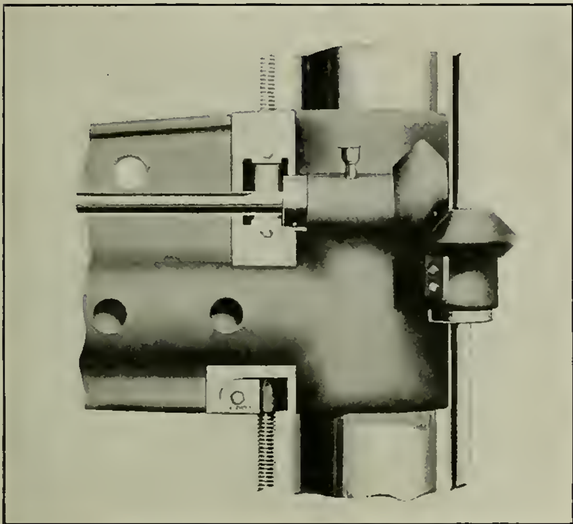


Fig. 2—Safety Nut Applied to Radial Arm

6-in., 6-ft. 6-in. and 7-ft. 6-in., respectively. The maximum height under the spindle and above the base is 50-in. The table height is 19-in. Motive power may be furnished by a 3-h.p. constant speed motor or a 3 to 1 variable speed motor as desired.

HYDROGEN GAS FOR CUTTING AND WELDING

While acetylene in combination with oxygen is widely used for welding and cutting, there are certain disadvantages in the process due to the explosive character of the acetylene. In order to eliminate the disadvantages incident to the use of acetylene, the Carbo-Hydrogen Company of America, Pittsburgh, Pa., has developed a gas known as carbo-hydrogen with the view to furnishing an efficient and safe medium for use in cutting and certain classes of welding.

Carbo-hydrogen is a product of the destructive distillation of suitable hydro-carbons and has a general analysis of 85 per cent hydrogen, the balance being light hydro-carbons. It is a fixed gas, permanent under all weather conditions, and does not solidify or leave any residue in the tank. Being a combustible gas and not an explosive, it is easy to use and safer than acetylene. No air or free oxygen is mixed with the gas in the process of manufacture.

Gases having a high B.t.u. value are necessarily slow in combustion and require a longer time to deliver a given amount of heat and a larger expenditure of oxygen than gases having a higher rate of combustion. For this reason, a smaller portion of oxygen is needed for a given amount of work where carbo-hydrogen is used. The gas maintains a very high rate of combustion and ignition and consequently generates an intense heat.

In cutting ferrous metals gases having a high carbon content change the character of the metal at the cut, hardening it so that machining or caulking is exceedingly difficult. It is claimed that metal cut by the carbo-hydrogen process on the other hand retains soft surfaces that can readily be worked, while the absence of slag increases the speed of cutting and produces a smoother surface.

The use of carbo-hydrogen for heavy welding on steel parts is not advocated by the manufacturers, although the process is said to be superior to the oxy-acetylene flame for welding softer metals, such as cast iron, copper, brass and aluminum. Carbo-hydrogen is also used on light gage iron and steel welding and for lead burning.

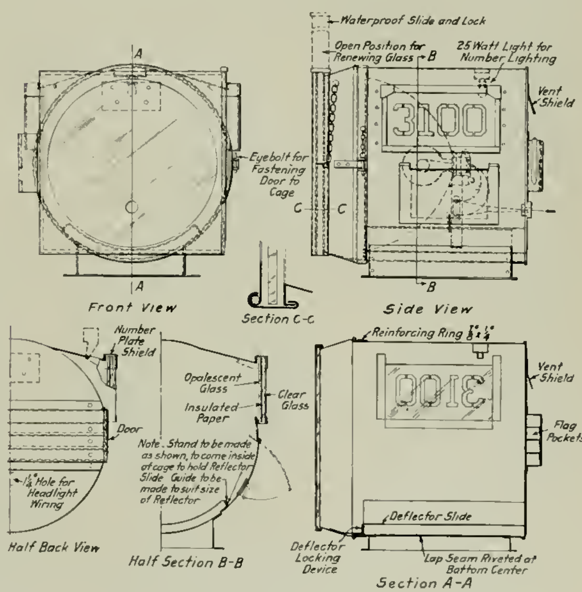
Among the advantages of carbo-hydrogen may be mentioned the absence of dangerous and poisonous gases in the products of combustion which often prove injurious to operators. Being composed largely of pure hydrogen, carbo-hydrogen burns almost entirely to water, while the combustion of acetylene and oxygen produces at least 50 per cent carbon monoxide. Carbo-hydrogen is supplied in drawn steel cylinders compressed to 1800 lb. per sq. in. The working pressure varies from 5 to 10 lb. per sq. in., making it possible to withdraw practically all the gas from the tank.

LUCAS HEADLIGHT AND MARKER LAMPS

A headlight casing having a number of improvements over the older types of casings, and a combination flag holder and electric classification or marker lamp, have been developed by A. N. Lucas, shop superintendent of the locomotive department of the Chicago, Milwaukee & St. Paul shops at Milwaukee.

HEADLIGHT CASING

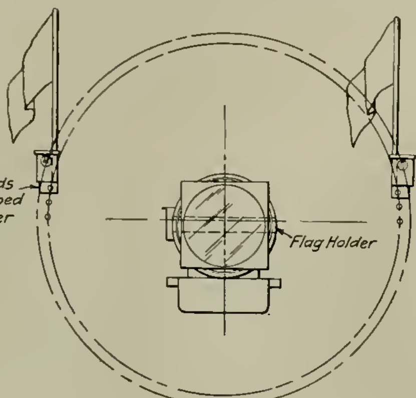
The headlight casing is designed to use an 18-in. square glass instead of the usual 18-in. round glass, thus eliminat-



Construction of the Headlight Casing

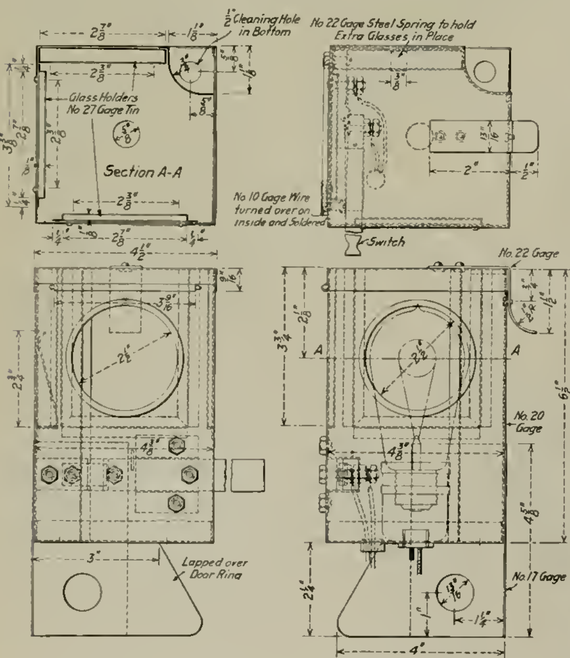
ing much of the breakage experienced in cutting and applying the round glass. The glass can be applied to this headlight without the use of putty or bolts or any cutting to fit, as standard 18-in. square glass is used, or the glass may be applied in two or more pieces.

The body of the casing is made so that the base plate passes through a slot at the bottom of the cage, stiffening it at the proper point. The slide for the reflector and the base plate are in one piece. This avoids double thickness and prevents the rusting of the headlight casing at this point, thereby increasing its life considerably. The extension for the glass showing the engine number is provided with a cover having a hinge, so that the numbers can readily be changed without the use of thumb screws, which might become rusted and inoperative. The front door is pro-



The Headlight Marker Lamp and Signal Flags Applied to the Front End

vided with a strong hinge and lock so that it may be fastened securely. On the left side below the engine number, a hinged door gives access to the interior of the case so that adjustment of the reflector or repairs may be made readily. Four pockets on the back of the headlight casing



Combination Marker Lamp and Signal Flag Holder

provide a storage place for the signal flags, which are shown in the illustration of the classification lamp.

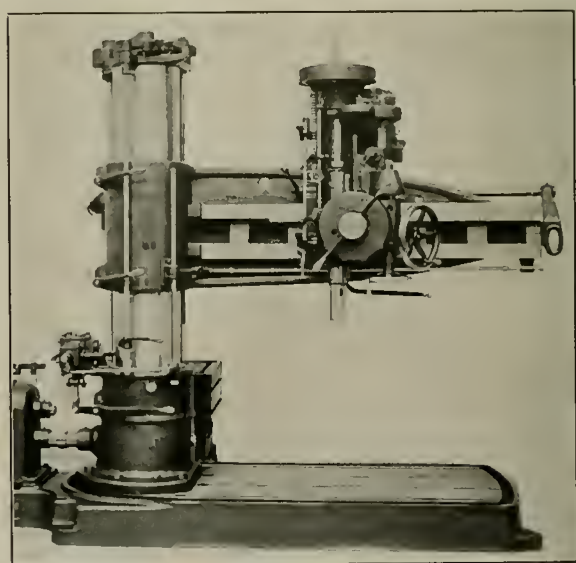
CLASSIFICATION LAMP

A combination flag holder and classification or marker lamp, which has been giving good results on the Chicago, Milwaukee & St. Paul, is shown in the illustration. This lamp is made of heavy galvanized sheet iron and all the joints are spot welded or riveted with eight-ounce rivets. Its construction is clearly shown in the drawing. The socket for the electric light bulb is at the bottom of the lamp and the switch is located at the lamp, making it necessary to go to the lamp in order to turn on the light, thus insuring that the engineman will know if the light is in operation. The lamp contains the usual lens and is provided with a receptacle to hold four extra lenses. After the lamp has been securely bolted to the front end, the part of the lamp flange extending over the front ring is turned down and prevents the lamp from turning in either direction.

A socket for a signal flag is located in one corner of the lamp, making a separate flag holder unnecessary. The flags used in the sockets of these lamps are somewhat smaller than the flags generally used, being 12 in. by 18 in. and the staff 22 in. long. The flags formerly in use were 18 in. by 24 in. and the staff 36 in. long. Due to the size of the flags and the long staff, breakages and losses of flags were frequent because of strong winds, but this smaller flag and shorter staff have eliminated practically all loss from this cause. These flags are of proper size to be inserted in the flag pockets shown in the illustration of the headlight casing; thus locating them in a convenient place and at the same time preventing the soiling or loss of flags which usually takes place when flags are thrown in the locomotive cab because no storage space is provided for them.

COLUMN CLAMPING DEVICE

The column of the Fosdick radial drill illustrated is clamped by a special combination pneumatic and hand clamping device, of which the most noticeable feature is the location of the air cylinder, bringing the pressure directly to the point of clamping. The device will operate equally well on high or low pressures. The clamping is accomplished by an air cushion at each end of the cylinder, formed



Fosdick Radial Drill with Clamping Device

by additional ports in the valve to insure a compression at the proper termination of each stroke. The valve is operated by mechanical connection to a horizontal shifter bar running along the radial arm. The advantage of this device is that it has no connection with and does not interfere with the movement of the spindle head. In case of failure of the air the pet cocks at either end of the cylinder are opened and the usual method of clamping by hand is used.

Railway Mechanical Engineer

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WE G ARANTEE, that of this issue 12,000 copies were printed; that of these 12,000 copies 11,191 were mailed to regular paid subscribers, 20 were provided for counter and news company sales, 223 were mailed to advertisers, 29 were mailed to employees and correspondents, and 537 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 107,710, an average of 9,792 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The Italian State Railways are said to have ordered a large number of oil-driven locomotives in Italy and the United States, in order to effect an immediate economy in coal.

The Belgian Minister of Railways, states Modern Transport, has bought from the British government 8,750 freight cars formerly used by the British army, which are still in France.

The British Ministry of Transport, according to a press report, is making arrangements for turning a number of munitions factory buildings into shops for the repairing of locomotives and cars now being returned from France, where they were used during the war.

Railway companies subject to the jurisdiction of the Board of Railway Commissioners for Canada have been granted an extension of time until September 30, 1920, within which to equip freight cars with safety appliances, as required by a recent order of the board.

The contract awarded by the German government to the Krupp Works for the construction of rolling stock, is reported by the United States commercial attache at The Hague, as calling for 2,000 freight cars of 15 tons capacity and 100 locomotives each year. It is said that the contract stipulates that the price must correspond to costs of material and labor and that the factory shall make a profit of only two per cent.

Exports of locomotives in August totaled 69, of a value of $1,539,540. This was considerably more than in July, but not as great as the exports of some of the preceding months. Over half the August total from the standpoint of value were destined for Japanese China. The exports of car wheels and axles in August totaled $1,302,546, nearly one-half of which total was destined for Japan. There were also large shipments to British India and to France.

Frank H. Clark, consulting engineer of New York City, has left the country temporarily, going to Peking to act as technical adviser to the Ministry of Communications of the Republic of China. Mr. Clark recently resigned as general superintendent of motive power of the Baltimore & Ohio and opened offices in New York City to undertake engineering investigations, report upon railway conditions and operations and co-operate in the preparation of plans and specifications for railway equipment and materials as well as to advise export firms, foreign railways and other concerns purchasing materials or equipment from United States manufacturers. He was at one time associated with David L. Barnes, consulting engineer of Chicago for four years, and later entered the service of the Chicago, Burlington & Quincy, where he held

F. H. Clark

RAILROAD CLUB MEETINGS

Club.	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian		Power House Operation	W. J. Harding	W. A. Booth	131 Charron Street, Montreal, Que.
Central	Nov. 13	Annual Dinner		H. D. Vought	95 Liberty Street, New York.
Cincinnati	Nov. 11	Annual Banquet and Entertainment		H. Boutet	101 Carew Building, Cincinnati, Ohio.
New England	Nov. 18	Economy of Stationary Power Plants	C. A. Brandt	W. E. Cade, Jr.	683 Atlantic Avenue, Boston, Mass.
New York	Nov. 21	Annual Electrical Night		H. D. Vought	95 Liberty Street, New York.
Pittsburgh	Nov. 28			J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	Nov. 14	Fuel Economy and Locomotive Operation	Robert Collett	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Nov. 17	Treatment of Water for Locomotive Boilers	Wm. M. Barr	J. M. Byrne	916 West 78th Street, Chicago, Ill.

successively the position of chief draftsman, mechanical engineer, superintendent of motive power and general superintendent of motive power. Resigning from that company in 1910, he joined the staff of the Baltimore & Ohio as general superintendent of motive power, a position he held for eight years. Mr. Clark is a member and has served as president of the American Railway Master Mechanics' Association and the Master Car Builders' Association.

Alfred LaMar, assistant director of sales of the war department, who went to Europe early in April to survey European markets, has returned to Washington and resumed his duties in the office of the director of sales. Mr. LaMar has the immediate supervision of sales of surplus war materials made for export, and directs the activities of the machine tool section of the office of the director of sales. While in Europe Mr. LaMar arranged the details of the visit recently made to the United States by a commission from the Construction Metallique which came to this country under the auspices of the Belgian government to inspect government-owned machine tools, with a view to purchasing. Mr. LaMar organized the machine tool section of the office of the director of sales shortly after the establishment of that office by the secretary of war.

MEETINGS AND CONVENTIONS

Master Boiler Makers' Association.—The executive committee of the Master Boiler Makers' Association has announced that the next annual meeting of that association will be held at the Curtis Hotel, Minneapolis, Minn., May 25-28.

Chicago Car Foremen's Association.—At the annual meeting of the Car Foremen's Association of Chicago, held at the Hotel Morrison on October 13, the following officers were elected: President, M. F. Covert, Standard Car Construction Company; first vice-president, James Reed, assistant master car builder, New York Central; second vice-president, E. H. Mattingly, general car foreman, Baltimore & Ohio; treasurer, F. C. Schultz, Chicago Car Interchange Bureau; secretary, Aaron Kline.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railroad Association, Section III.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti. C. & N. W., Room 411, C. & N. W. Station, Chicago.

Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke secretary, Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

Chief Interchange Car Inspectors' and Car Foremen's Association.—H. J. Smith, D. L. & W., Scranton, Pa.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.

International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car and Locomotive Painters' Association of U. S. and Canada. A. P Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

Railway Storekeepers' Association.—J. P. Murphy, Box C. Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

GENERAL

A. B. Corbett, shop superintendent of the Missouri, Kansas & Texas, at Parsons, Kan., has been appointed assistant mechanical superintendent of the Missouri, Kansas & Texas of Texas, with office at Denison, Tex., succeeding R. W. Burnett.

W. Malthaner, general master mechanic of the Northwest district of the Baltimore & Ohio, Western Lines, with headquarters at Cleveland, Ohio, has been appointed acting superintendent of maintenance of equipment, with headquarters at Cincinnati, Ohio, succeeding the late Matthew J. McCarthy. Mr. Malthaner was born at Salem, N. Y., on August 4, 1874. He entered railroad service as a machinist apprentice on the Delaware & Hudson at Green Island, N. Y., in 1889, and at the end of four years was made a gang foreman in the same shop, serving in this capacity on various classes of work until 1896. He then left railway work, taking employment with the General Electric Company as a machinist, but returned after two years to the Green Island shops of the Delaware & Hudson as foreman of the air brake department. In 1900 he became terminal foreman of the same road at Schenectady, N. Y., and after two years in this capacity was appointed general foreman at Plattsburg, N. Y. In 1914 he was made division master mechanic of the Saratoga & Champlain divisions of the Delaware & Hudson, occupying this position until 1912, when he was transferred to the Susquehanna division. Early in 1915 he accepted the position of shop superintendent of the Baltimore & Ohio at Newark, Ohio. and in 1917 was appointed general master mechanic of the Northwest district. This is the position he held when he was recently appointed acting superintendent maintenance of equipment.

W. Malthaner

F. W. Boardman has been appointed fuel supervisor of the Texas & Pacific, the Trans-Mississippi Terminal Railroad, the Weatherford, Mineral Wells & Northwestern, the Gulf, Texas & Western, the Denison & Pacific Suburban Railroad, and the Fort Worth Belt Railroad, with headquarters at Dallas, Texas, succeeding W. L. McMurray, assigned to other duties.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

J. O. Goodwin, road foreman of engines of the Michigan Central, with office at West Bay City, Mich., has been appointed division master mechanic to succeed J. S. Jennings, at Bay City.

W. G. Johnston, master mechanic of the Newark division of the Baltimore & Ohio, Western Lines, at Newark, Ohio, has been appointed general master mechanic of the

Northwest district, with headquarters at Cleveland, Ohio, succeeding W. Malthaner.

A. M. Meston has been appointed district road foreman of engines and oil burning inspector of the Southern Pacific, with headquarters at Los Angeles, Cal., succeeding F. W. Corcoran, assigned to other duties.

H. L. Moore, road foreman of engines of the Southern Pacific at Tucson, Ariz., has been appointed road foreman of engines of the Coast division, Southern Pacific, with headquarters at San Francisco, Cal., succeeding C. H. Holdredge.

Franklin E. Cooper, shop superintendent of the Baltimore & Ohio Western Lines at Newark, Ohio, has been appointed master mechanic with headquarters at Newark, to succeed W. D. Johnson. Mr. Cooper was born on October 22, 1882, at Connellsville, Pa., and was educated in the public schools at McKees Rocks, Pa., and at Pittsburgh High School. His railroad service dates from February 1, 1903, when he took employment with the Pittsburgh & Lake Erie at McKees Rocks as a machinist apprentice, later being employed there as machinist. Afterwards for a time he was material inspector for the New York Central, but subsequently returned to the Pittsburgh & Lake Erie as apprentice instructor at McKees Rocks, and was later assistant machine shop foreman and then machine shop foreman. On April 16, 1916, he accepted a position with the Baltimore & Ohio as general foreman of the Newark shops, being appointed superintendent of shops on February 1, 1917. On August 1, 1919, the positions of master mechanic and superintendent of shops were combined, and Mr. Cooper was appointed to the position with the title of master mechanic, having jurisdiction over the locomotive and car departments of the Newark division.

F. E. Cooper

SHOP AND ENGINEHOUSE

J. C. Brekenfeld has been appointed shop supervisor of the St. Louis-San Francisco, with headquarters at Springfield, Mo., succeeding A. J. Devlin.

John J. Davis, general foreman of the machine shops of the Pennsylvania at Philadelphia, Pa., has been transferred to Altoona, succeeding Henry S. Schum, assigned to other duties because of illness.

PURCHASING AND STOREKEEPING

W. W. Blowney has been appointed assistant purchasing agent, in charge of purchases and stores, of the Toledo, St. Louis & Western and the Detroit & Toledo Shore Line, with headquarters at Toledo, Ohio.

G. V. Booth, storekeeper of the Detroit, Toledo & Ironton, has been appointed general storekeeper at Jackson, Ohio.

C. B. Porter has been appointed acting purchasing agent of the Texas & Pacific and allied lines, with office at Dallas, Tex., R. I. Irwin, purchasing agent, having been granted leave of absence.

OBITUARY

Eugene Chamberlain, who recently retired as manager of the equipment clearing house of the New York Central lines, died suddenly September 30 at his home in Mt. Vernon, N. Y. Mr. Chamberlain was in his 70th year. He began railroad service in Ohio with the Wabash. Some time after entering the employ of the New York Central he was appointed master car builder of the Western division with headquarters in Buffalo. In 1893 he left railroad service to engage in business, but in 1899 became superintendent of equipment of the Brooklyn Rapid Transit and five years later was called back by the New York Central to the position he held at the time of his retirement. He was a founder and senior past president of the Central Railway Club of Buffalo, past president of the New York Railroad Club and was active in the Master Car Builders' Association and the American Railway Master Mechanics' Association, now known as Section III—Mechanical, American Railroad Association.

E. Chamberlain

Morgan K. Barnum, corporate mechanical engineer of the Baltimore & Ohio, died October 26 at Baltimore, Md. Beginning in 1917, Mr. Barnum acted as assistant to the vice-president of the Baltimore & Ohio, giving special attention to the conservation of materials. He graduated from Syracuse University in 1884 with the degree of A.B., and later received the degree of A.M. After graduation he began work in the shops of the New York, Lake Erie & Western, at Susquehanna, Pa. He soon became machinist and mechanical inspector and two years later general foreman at Salamanca, N. Y. In 1889 he was appointed general foreman of the Louisville & Nashville at New Decatur, Ala., and in September of the following year became superintendent of shops of the Atchison, Topeka & Santa Fe at Cheyenne, Wyo. During the years between 1890 and 1904 he served with the Union Pacific, Southern and the Chicago, Rock Island & Pacific. In 1904 he was appointed mechanical expert of the Chicago, Burlington & Quincy. In April, 1910, he became general superintendent of motive power of the Illinois Central and the Yazoo & Mississippi Valley. He became general mechanical inspector of the Baltimore & Ohio in July, 1913, and in September, 1914, superintendent of motive power, the position he held when he was appointed corporate mechanical engineer.

M. K. Barnum

SUPPLY TRADE NOTES

The Southern Wheel Company, St. Louis, Mo., is considering plans for additions to its plant to cost approximately $400,000.

The American Brake Company, St. Louis, Mo., is planning on erecting a four-story machine shop, at an estimated cost of $225,000.

James S. Hearons has become affiliated with the Gustin-Bacon Manufacturing Company, Kansas City, Mo., as railroad representative.

The Bowen Motors Railway Corporation, Terre Haute, Ind., has completed plans for a plant to produce gasoline-propelled passenger cars.

The Chesapeake Iron Works, Baltimore, Md., have opened an office in the Woolworth building, New York, which is in charge of H. L. Mode.

The Chicago Pneumatic Tool Company, Chicago, on October 1, removed its Birmingham office from 801 Brown Marx building to 1925 Fifth avenue, north.

The name of the Schroeder Headlight & Generator Company, Evansville, Ind., was changed to Sunbeam Electric Manufacturing Company on September 27, 1919.

Horace S. Wilkinson, of Syracuse, N. Y., has been elected chairman of the Crucible Steel Company of America, Pittsburgh, Pa., to succeed Herbert Du Puy, resigned.

T. W. Holt, assistant general manager of the Curtain Supply Company, Chicago, has been elected a director and secretary, in place of William S. Estell, resigned.

Louis J. Schneider has been appointed general sales manager of the Clark Tructractor Company, Chicago. Mr. Schneider is a graduate of Stevens Institute of Technology, Hoboken, N. J., and is a member of the Society of Automotive Engineers, as well as the American Society of Mechanical Engineers. He served in the engineering department of the Hyatt Roller Bearing Company during 1911 and in the sales department from 1912 to 1916; during the early part of 1917 he was sales manager of the Jackson Rim Company, Jackson, Mich., and later in the same year he became sales manager of the Harrison Radiator Company, Lockport, N. Y., which position he resigned to take charge of the sales department of the Clark Tructractor Company.

L. J. Schneider

L. A. Muttart, railroad salesman for the Western Electric Company, Inc., Chicago, with headquarters in that city, has been promoted to manager of the Chicago railroad sales department of that company.

C. N. Replogle has resigned as general manager of the Ralston Steel Car Company, Columbus, Ohio, to become general manager of the new plant of the Timken Roller Bearing Company, Canton, Ohio.

R. H. Brown, Jr., of the St. Louis, Mo., office of the Ingersoll-Rand Company, New York, has been appointed manager of the new offiice of the company in the Sam Houston Life Building, Dallas, Tex.

The Vapor Car Heating Company of Canada, Ltd., with headquarters at Montreal, Que., has taken over the business of the Canadian branch at Montreal of the Vapor Car Heating Company, Inc., of Chicago.

The Vanadium Corporation of America, New York, has bought the property and rights of the American Vanadium Company, and has elected officers as follows: J. Leonard Replogle, president, Merrill G. Baker, vice-president; Lawrence E. Diffenderfer, treasurer, and Edward F. Nickerson, secretary. J. Leonard Replogle was born in Bedford county, Pa., on May 6, 1876, and was educated in the public schools of Johnstown. He entered the employ of the Cambria Steel Company as office boy at the age of 13, and served successively as clerk, shipper, assistant superintendent of the axle department, superintendent of the forge, axle and bolt departments, assistant to the assistant general manager, superintendent of the order department, assistant general manager, assistant to president, and in September, 1912, was elected vice-president and general manager of sales. In February, 1915, he resigned from the Cambria Steel Company to become vice-president and general manager of sales of the American Vanadium Company, and subsequently became president and general manager of sales of the same company. He is also president of the Wharton & Northern Railroad, and chairman of the board of directors of the Wharton Steel Company. Mr. Replogle, during the war, also served as director of steel supplies for the War Industries Board and had conferred upon him recently by the French government the decoration of Chevalier of the Legion of Honor in recognition of the service he rendered for the Allied cause.

J. Leonard Replogle

A. Clark Moore, vice-president of the Safety Car Heating & Lighting Company, Chicago, has resigned to become associated with the Globe Seamless Steel Tube Company, Chicago, with temporary headquarters in that city.

O. A. Phenix, associated with the sales department of the United States Graphite Company, Saginaw, Mich., with office at Birmingham, Ala., has been promoted to advertising manager with office at Chicago, succeeding George A. Cooper.

The Lyon Metallic Manufacturing Company, Aurora, Ill., has opened a New England district sales branch at 161 Devonshire street, Boston, Mass., in charge of J. B. Throckmorton, formerly New York City representative of the company.

The American Car & Foundry Company has purchased two pieces of property adjacent to its plant in Chicago at a consideration of approximately $90,000. One of the properties is 361 ft. by 240 ft. and the other 100 ft. by

240 ft. The company contemplates the building of an addition to the present plant which, together with the rebuilding of the old plant, will cost approximately $2,000,000.

The Rock Island Brake Shoe & Foundry Company, Rock Island, Ill., has been incorporated with $200,000 capital stock to manufacture brake shoes and other railway supplies. The incorporators are Simon Lewis, Hyman Lewis and M. I. Morris.

E. L. Chollman, formerly with the Southern Locomotive Valve Gear Company, has been made vice-president and sales manager of the Paxton-Mitchell Company, Omaha, Neb. Mr. Chollman was born on August 5, 1877, at Omaha, Neb. He entered railway service in 1892 as a machinist apprentice on the Union Pacific at its Omaha shops. From 1897 to 1901 he was machinist on various railroads and from 1901 to 1902 was roundhouse foreman on the Union Pacific, with office at Evanston, Wyo. In 1902, he was appointed assistant general foreman at Cheyenne, Wyo. From 1903 to 1904 he was master mechanic for the La Follette Coal & Iron Railway Company, La Follette, Tenn. In the latter year he was appointed general foreman on the Southern, with office at Alexandria, Va. In 1905 he was appointed general foreman at Danville, Va., and in 1906 was transferred to Greensboro, N. C., which position he held until 1909 when he was appointed superintendent of car shops at Knoxville, Tenn. In July, 1914, he was elected vice-president of the Southern Locomotive Valve Gear Company, Knoxville, Tenn., a position which he held until his recent election as vice-president and also manager of the Paxton-Mitchell Company.


E. L. Chollman

C. E. Hutchison, formerly district representative at St. Louis, Mo., of the La Belle Iron Works, Steubenville, Ohio, has resigned to become associated with the Youngstown Sheet & Tube Company, Youngstown, Ohio, with headquarters at Cleveland, Ohio.

The Armstrong Brothers Tool Company, Chicago, is erecting an addition to the drop forge department, a new building for the hardening and heat treating department and a new reinforced concrete building for the general office, finished stock and shipping department.

G. E. Anderson, formerly assistant to the vice-president of the American Locomotive Company, has been appointed assistant eastern sales manager of the Duff Manufacturing Company, Pittsburgh, Pa., with headquarters at the eastern sales offices, 50 Church street, New York.

The Pollak Steel Company, Cincinnati, Ohio, has appointed the C. A. S. Engineering Company, 790 Woodward avenue, Detroit, Mich., as its representative in the Detroit district, which embraces Michigan and northern Ohio, including the cities of Toledo, Elyria and Cleveland.

Charles H. Small and George F. Shade have established an office in the Monadnock building, San Francisco, Cal., as agents for the Sargent Company, Chicago, auxiliary locomotive device manufacturers. They will also act as agents for other manufacturers of railway specialties.

George R. Woods has resigned from the Allied Machinery Company of America, New York, to become manager of the New York office of R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland. Mr. Woods has been in Europe studying industrial and economical conditions and returns to New York to take up his new duties.

H. V. McKedy, assistant to the vice-president in charge of sales of the American Locomotive Company, New York, has severed his connection with that company. He has been appointed eastern representative of the Glidden Company, Cleveland, Ohio, with headquarters at 636 West Thirty-fourth street, New York.

J. H. Mitchell, who has for some time been manager of sales of the western district for the Pressed Steel Car Company and the Western Steel Car & Foundry Company, with headquarters in Chicago, left recently for Havana, Cuba, to assume the position of executive vice-president of the American Steel Company of Cuba.

Louis W. Ulmer, has been appointed eastern railway sales representative of the Detroit White Lead Works, with office in Philadelphia, Pa. Mr. Ulmer has recently been released from his duties in the United States Marine Corps and was connected with the Detroit White Lead Works before he entered the military service.

C. W. Cross, special railroad representative of the Chicago Pneumatic Tool Company, with office at Chicago, has been appointed manager of western railroad sales with the same headquarters, succeeding L. C. Sprague, who has resigned to become general mechanical inspector of the Galena-Signal Oil Company, with office at Minneapolis, Minn.

Major C. G. Carothers who served in the U. S. Army as captain and major from September, 1917, to September, 1919, has been appointed Chicago railroad representative of the B. F. Goodrich Rubber Company, with headquarters at Akron, Ohio, succeeding F. O. Slutz, promoted. Major Carothers was born on August 31, 1881, at Mattoon, Ill., and was educated in the grade and high schools of his native town. He served an apprenticeship as machinist at Mattoon on the Cleveland, Cincinnati, Chicago & St. Louis, and then worked for a number of western railroads. He subsequently attended Purdue University, Lafayette, Ind., and was graduated as a railway mechanical engineer in 1912. From August of that year to August, 1914, he was mechanical engineer with the Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio. He then served to September, 1917, as senior mechanical engineer with the Interstate Commerce Commission, Division of Valuation, Southern District, with headquarters at Chattanooga, Tenn. In July, 1917, he received a commission as captain in the Engineers Reserve Corps and was called to active service the following September to attend the Second Engineer Officers' Training Camp, American University, Washington, D. C. He subsequently was attached to the 301st Engineers of the 76th Division at Camp Devens, Ayer, Mass., and in January, 1918, was sent to France to report to the general superintendent of motive power, Colonel H. H. Maxfield of the Railway Trans-


Maj. C. G. Carothers

portation Corps. He subsequently served in the railroad yard at Is-sur-Tille as master mechanic and built a shop there, also one at Villa-le-Sex, the advance section ammunition depot. He later served as superintendent of motive power of the 13th Grand Division, with headquarters at Is-sur-Tille.

Fred J. Holden, who has represented B. M. Jones & Co., Inc., New York, for a number of years, has been appointed manager of the railway department. Austin Savage, formerly of Samuel Osborn & Co., Ltd., Sheffield, England, is now located in New York and has been elected secretary and treasurer of B. M. Jones & Co., Inc.

Lawrence A. Rowe, mechanical inspector on the Atchison, Topeka & Santa Fe, with headquarters at Chicago, has been appointed general manager of the Universal Packing & Service Company, with office at Chicago. This company has been organized to manufacture and sell spring journal box packing and in addition will maintain a service department.

The Detroit Star Grinding Wheel Company has been formed by merging the business of the Detroit Grinding Wheel Company and the Star Corundum Wheel Company, both of Detroit, Mich. The officers of the new company are John R. Kempf, president; J. T. Wing, vice-president; F. H. Whelden, secretary and treasurer. Edward N. Dodge, formerly with the Norton Company, Worcester, Mass., has been appointed general sales manager. The company's plant and offices will be at 241-61 Cavalry avenue, Detroit, Mich.

H. W. Ross has been elected vice-president of Templeton, Kenly & Co., Ltd., Chicago, manufacturers of Simplex jacks. In 1916 Mr. Ross was designated as engineer in charge of installing a bureau of standards for the Quartermaster Corps, U. S. A., for the purpose of testing and selecting various motor machine shop tools and accessory equipment for the United States government. In 1917 he was called to Washington to purchase machinery, tools and auto accessories for use of the Motor Transport Corps in France, on August 1, 1917, receiving his commission as captain, later being promoted to major. He went overseas, where he was connected with the Motor Transport Corps in an engineering and purchasing capacity and was later sent to Spain and Portugal in connection with the general purchasing board. After the close of hostilities Major Ross was selected as officer in charge of sales of Motor Transport Corps equipment in connection with the United States Liquidation Commission, and he had charge of the appraisal and selling of the vast quantities of motor cars, trucks, motor cycles and machinery that the government had accumulated in France. Major Ross returned to the United States on September 15, and at his request was mustered out of the service soon thereafter. His new work covers the general sales management of Simplex jacks, and he will give particular attention to the Simplex pole pulling and pole straightening and special emergency jacks used by steam and electric railways and other public utility companies.

H. W. Ross

CATALOGUES

Forging.—A series of pamphlets entitled National Forging Machine Talks is being distributed by the National Machinery Company, Tiffin, Ohio. No. 36 describes a method of forming the eyes on brake hangers.

Curtain Fixtures.—Bulletin F-1, published by the Curtain Supply Company, New York, describes and illustrates the action of the ring curtain fixtures developed by this company and contains sketches showing standard types of open and enclosed grooves to aid in selecting the proper style of ring fixture.

Electric Arc Welding.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued Circular No. 7149, covering the process of electric arc welding and the necessary apparatus required. A comparison is made of the different processes of welding and the advantages of electric arc welding are pointed out.

Care of Electric Hoists.—Facts for Operators of Electric Hoists is the title of a four-page pamphlet published by the Electric Hoist Manufacturers' Association, New York, for the guidance of electric hoist operators. It deals with such matters as connections, lubrication, and the care of the motor, controllers and ropes.

Asbestos.—The Magnesia Association of America, Philadelphia, Pa., is now publishing a monthly booklet which is devoted to the interests of the asbestos and magnesia industries. The magazine is known as "Asbestos" and contains information regarding market conditions and prices, and articles on subjects of special interest to users and manufacturers of asbestos and allied products.

Steel Treating. — Detailed instructions for treating Colonial tool steel and tools have been compiled as the result of experience, by the Colonial Steel Company, Pittsburgh, Pa., and published in a booklet entitled The Colonial Tool Steel Treating Book. In addition to the directions for hardening and treating, the book contains a complete list of tools with the grades of Colonial steel best adapted for their use, with a separate list of railroad tools.

Feedwater Heater.—Bulletin 5 of the Locomotive Feed Water Heater Company, New York, is a complete treatise on the application and operation of the Type *E* locomotive feedwater heater developed by this company. A colored chart shows how the heater performs its functions and is arranged to show in a graphical manner just where all of the heat that comes from the burning coal on the grates of the locomotive is distributed and its amount at various points throughout the route between the fuel bed and the top of the stack. A sectional drawing shows the arrangement of the equipment on a locomotive, with all pipe connections.

Welding Locomotive Fireboxes.—The Air Reduction Sales Company, New York, has prepared and published a 40-page booklet, No. 4, describing the Airco process of oxy-acetylene welding as applied to locomotive firebox welding instead of riveting. The booklet is designed to help the operator by showing him the proper methods to follow when welding a firebox. It describes the operations necessary for full and semi-welded side sheets, cracks in side sheets, full welded door and flue sheets, patches on fireboxes and flue sheets, patches on mudring, welding of door collars and door holes, building up worn edges of fireboxes, etc. The different operations are very clearly illustrated by full page drawings.

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CONTENTS

THE STORY WRITING CONTEST

In the November issue of this publication a story writing contest was announced which any one in the railroad field is eligible to enter.

The type of story desired must depict the romance of railroad life or deal with the problems that arise in the shops or yards, on the road, or in the office. The writer need not offer a solution of the problem he may describe—though that would be desirable—but should set forth as clearly as possible the thought he wishes to bring out; others may find the solution.

Literary finish is desirable, but the merits of a story will be judged more by the presentation of the subject and the clearness with which the action is described or the characters portrayed.

These stories may be told in as many words as are necessary to tell the tale properly, but if it is feasible they should range from 1,200 to 2,500 words.

The contest closes on April 1, 1920. In addition to paying at our regular space rates for any stories deemed suitable for publication, the writer of the story adjudged to be the best will receive a first prize of $75, the second $50 and the third $25.

Deflection of Staybolts

In an article appearing elsewhere in this issue, George L. Fowler describes a series of tests conducted to determine the action of the firebox sheets and the resulting deflection of the staybolts in locomotive boilers. The tests demonstrate the superiority of the flexible staybolt over the rigid bolt. The effect of changes of temperature on the firebox sheets, not only proved the absolute necessity of a flexible construction, but also suggests a line of study as to the effect—on the firebox sheets—of the opening of the firedoor for the purpose of firing. A careful study of the data covering these tests will show the desirability of further investigation of this subject and it is to be hoped that the work will be continued.

Failures of Welded Firebox Seams

The annual report of the chief of the Bureau of Locomotive Inspection calls attention to several serious failures which occurred in fireboxes having seams welded by autogenous processes. The examples cited bring out very clearly that while low water was directly responsible for the failures, the welded seams apparently gave way at a lower temperature than riveted seams, causing more extensive rupture with consequent greater damage, which no doubt contributed to the increased number of deaths due to boiler explosions. It will be conceded that the safety of men operating the locomotive is of prime importance and no method of construction should be used which increases the hazard due to low water. For this reason the recommendation for limitation in the use of autogenous welding in boilers must be carefully considered. Before discarding the practice, however, it would be well to give a thorough test to methods of examination of welds to determine the quality of the metal added, which have been developed during the past year to a point where they will serve as a fairly reliable indication of the strength of the seam.

If this method does not prove satisfactory it is possible that minor changes could be made in the construction of the firebox to lessen the explosive force of the escaping steam. It has been the practice on some roads to install several rows of crown stays with small heads at the front of the crown sheet. In case the sheet became overheated these stays would offer little resistance and the sheet would bag before the water level fell any great distance. This has been found to be a satisfactory method of reducing the violence of boiler explosions and a similar type of construction used in connection with welded seams might overcome the objections mentioned in Mr. Pack's report.

The Shop Employees' Wage Agreement

The agreement covering wages and working conditions, which went into effect in October includes some remarkable provisions. No one can deny the justice of having definite rules to govern the practices in shops and these are on the whole not open for serious criticism. In the classification of the employees, however, the policy of placing the skilled and unskilled workers on the same basis has prevailed, with evident injustice to the more highly skilled men. Apparently an effort has been made to broaden the scope of the work assigned to each craft as much as possible. As a result, a tool maker and the operator of a tool grinder are placed in the same class. The valve setter and the man who removes superheater units from the front end receive the same rate of pay. It is hardly clear why the work of removing parts from cars to be dismantled should demand such special skill that carmen are required to handle it. On the whole the agreement seems to provide plenty of positions on the railroads for inferior mechanics, but little to attract the better class. The rule specifying that applicants for employment will be required to make statement only as to their ability and the addresses of relatives apparently furnishes abundant opportunity for undesirables of all kinds to enter railroad service.

The rigid application of the seniority rule, with the provision for posting bulletins concerning vacancies, removes from the foreman the right to select the men best fitted for the work. The only assurance provided is that the workman must be able to meet the minimum requirements of the position. Such abrogation of one of the very important functions of the foreman can hardly fail to have a bad effect upon the supervision. Some of the provisions of the agreement result in increasing the actual hourly rate of pay to a considerable extent. All employees required to check in and out on their own time are paid for an extra hour each week. Where three shifts are employed, 20 minutes are allowed for lunch without a corresponding deduction from the wages. In case a machinist worked an eight-hour shift for seven days a week, these two rules would increase the hourly rate of pay from 72 cents to 76.4 cents, or over six per cent. With the large number of employees working in roundhouses this increase in the pay-roll is quite appreciable.

Should the Front Waste Plug Be Retained

For some time a number of railroads have had in use a method of packing journal boxes without the use of the plug which is ordinarily placed at the end of the journal. Those who have been active in securing the adoption of this method of packing journal boxes claim that by its use a saving of 15 per cent in oil and waste is effected and better lubrication is obtained. The practice has not been in sufficiently general use to determine conclusively whether these claims are borne out in practice.

It would no doubt be feasible to operate cars with very small pads of waste under the journal if the cars were given attention at short and regular intervals. The question arises whether the elimination of the front waste plug necessitates more frequent inspection and setting up of the packing. Those who still adhere to the use of the front waste plug claim that it serves as an extra reservoir of oil, assists in keeping the dirt out and prevents the waste from working forward when the car is in motion. Considerable trouble has been experienced on cars packed without the front plug, due to the packing working forward, causing the inner end of the journal to become dry and heat. Some attempt has been made to standardize the method of packing without the front plug. If the operating results are as satisfactory as those secured by the former method this would no doubt be desirable. Delays due to hot boxes are so serious and costly that this method should be subjected to long and thorough trial before it is adopted as a standard practice.

Watch the Brake Shoes

The braking of modern railroad trains is so important a subject and the cost of the brake shoes such a large item in railroad expenditures that the use of brake shoes must be given very careful attention to keep the costs within reasonable limits. As the most efficient brake rigging ever made can function only through the brake shoe, which comes in contact with the wheel, it is obvious that the composition and use of the brake shoe is a vital matter. With the high speeds and heavy equipment in use at the present time the brake shoe not only must possess high frictional qualities, but must be of such texture and be reinforced in such a manner that it will also be durable and safe. By long experiment these desirable qualities have been attained in a very high degree.

The cost of the type of brake shoe required for the average service is considerably in excess of that of an ordinary plain casting and it is incumbent on those men who apply them to get the greatest possible wear from each brake shoe before it is sent to the scrap pile. An inspection of the brake shoe scrap in almost any railroad yard will reveal great numbers of brake shoes that have been removed and scrapped because of taper wear, with only a small part of the casting worn off in service. This is a condition that can in most cases be remedied by giving closer attention to the wear of the shoes, removing the shoe from the brakehead when the tapered wear becomes apparent, and applying it to another wheel with the position of the shoe reversed. This is particularly true of driving brake shoes, and as the average weight of the type of driver shoe most commonly used is over 50 lb., it is possible to effect a great saving in locomotive brake shoe cost by reversing the shoes before the tapered wear has progressed too far to permit of doing this. Another means of brake shoe conservation is to remove partly worn shoes from the most severe service, where a brake shoe failure might prove disastrous and utilize such shoes on lighter equipment.

These and other means of brake shoe economy are very well known to most railroad men, but unfortunately the brake shoe is too often regarded as a secondary matter and is not given the attention that its importance merits. That it pays to give close attention to brake shoe wear was proved on at least one railroad, where in the course of a year the brake shoe costs were reduced many thousands of dollars without any appreciable increase in the labor cost of application. This result was achieved, despite the fact that there was a very considerable increase in both the number and size of the rolling stock.

The foremen at roundhouses and terminals should be on the alert and by close attention to the application and removal of brake shoes should keep the consumption at the lowest possible figure.

Car Department Apprentices

The provisions for apprentices in the car department are not sufficiently attractive as compared with the rules for apprenticeship in the other crafts to make car work attractive to young men, and it is doubtful whether the railroads will find it possible to recruit the necessary number of car department apprentices under these rules.

The rate of pay in the car department is lower, yet the length of apprenticeship is the same as in the other trades. Even if a young man for some reason preferred to enter the car department it would be to his advantage to enter as a helper apprentice, where he would receive 49 cents an hour instead of the 29-cent rate paid the regular apprentices. The helper apprentice, to be sure, is required to spend five years before he is rated as a mechanic, but the compensation is so much greater that it would more than offset the disadvantage of the longer apprenticeship. Those who framed the agreement apparently realized that there would be difficulty in securing apprentices in the car department and a special provision has been made for promoting helpers if necessary. The need of apprentices in the car department is becoming more generally recognized and if the present schedule operates as is anticipated it is to be hoped that service in the car department will be made more attractive for those who desire to enter apprenticeship courses.

Draft Gear for High Capacity Cars

The performance of freight cars of unusually high capacity has proved so satisfactory from an operating standpoint on the roads where they have been tried that this type is finding much favor and it is probable that cars with capacities of approximately 100 tons will be built in considerable numbers when the railroads again enter the market for equipment. With any such radical increase in the size of the unit there are important points in design to be worked out and the question naturally arises whether some of the standards developed for smaller cars will serve satisfactorily on cars of such high capacity. In some cases it is possible to increase the number of parts used, thereby keeping down the stresses to which each unit is subjected. Where the maximum journal capacity of eight pairs of wheels is not sufficient to carry the load six-wheel trucks have been used and other difficulties can be met in a similar manner.

One of the important appliances used on freight cars which is limited in size because of standard dimensions is the draft gear. With heavier cars greater draft gear capacity will be needed and it is doubtful whether the necessary capacity to absorb shocks can be obtained within the present narrow space restrictions. No satisfactory tandem arrangement of friction draft gear has been devised, and if it could be developed it is doubtful whether its use would be advisable, due to the difficulty of inspection. Under certain circumstances one gear might be placed above the other, but this would raise the floor level and therefore could be applied only to certain types of cars.

It would seem that the first change that should be made in adapting draft gears for higher capacity cars would be to increase the travel to approximately four inches. This extra travel should not be objectionable because the large size of the cars reduces the number of units in the train. This would offer an opportunity for increasing the capacity of the gear approximately 75 per cent. Even with the increased travel the large amount of work to be absorbed might cause unduly rapid wear of the gear. If this proves to be the case it would be advisable to increase the space between the center sills and possibly also the distance between the front and rear coupler stops.

An incidental advantage to be gained by wider spacing between the center sills would be greater angular movement of the couplers. The present spacing allows very little side play for the coupler shank and in rounding curves the coupler often bears very heavily against the sides of the striking casting. In fact, the stresses set up are sometimes sufficient to bend the coupler shank. In designing long cars provision should be made for greater angular movement of the coupler. This can only be provided by an increase in the distance between the center sills.

Machine Shop Limits Output

That the output of practically every locomotive repair shop is limited by its machine shop capacity no one familiar with the conditions will be likely to deny. Should there be a doubt on this point it can be set at rest by even a casual inspection of the average railway machine shop. In most shops the floor is so congested with motion work and running gear parts in various stages of repair that it is difficult to pass from one machine to another. The link job, in particular, is usually behind, with link hangers, trunnion blades, radius bars and combination levers everywhere in evidence and all waiting for machine work. Perhaps the rod job has been "caught up" but the unexpected receipt of four or five sets of rods from the roundhouse, (marked "rush") places this work hopelessly in arrears again. The wheel and driving box job is another bugbear and many a locomotive has been delayed in the shop one or more days due to late wheeling.

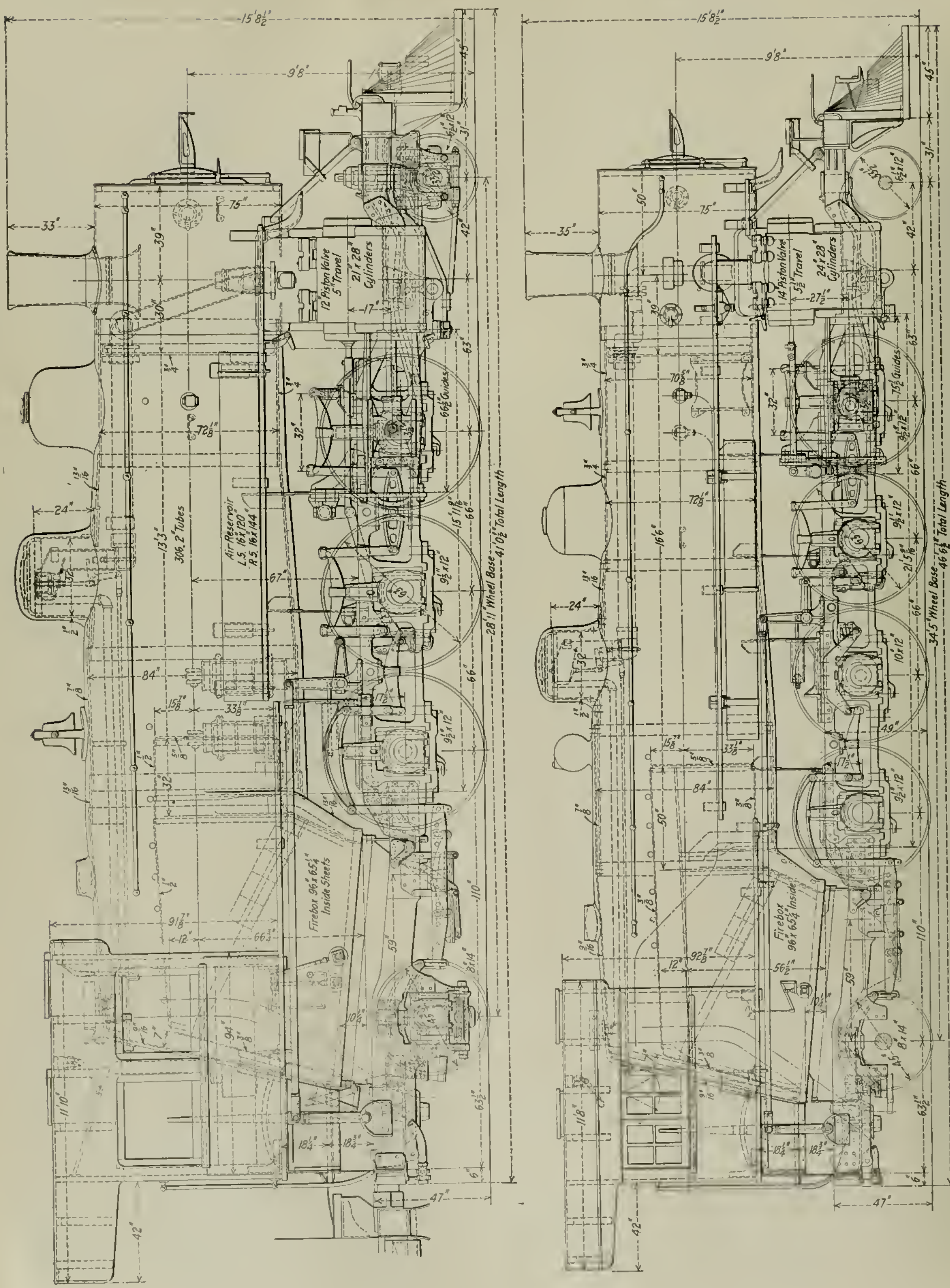
With an increase of 57 per cent in freight traffic alone in the past four and one-half years, it is evident that the new business cannot be handled unless locomotives are kept on the road. They cannot be held in repair shops while repairs are made with the present inadequate machine shop equipment and facilities, consequently the number held in roundhouses for heavy work is rapidly increasing. It is hoped that Congress in turning the roads back to their owners will make arrangements that will permit the roads to finance improvements and bring all their equipment up to the standard necessary to take care of the increased business.

Not only is it essential to provide increased machine tool equipment; machine foremen can help out the situation by keeping posted on improved methods and using what machines they have to the best advantage. Are they doing this? It is generally conceded that driving box shoes and wedges should be machined on a horizontal miller, but many shops are still planing them. Slightly worn guides should be trued up by grinding, but here again the planer is used, which requires more time for a poorer job. Such modern machines as are already installed should be used to their utmost capacity and in addition new machinery must be purchased in the near future or the country's industries will be seriously handicapped by the lack of motive power.

NEW BOOKS

Applied Science for Wood-Workers. By W. H. Dooley, 446 pages, 5¼ in. by 7½ in., illustrated, bound in cloth. Published by the Ronald Press, New York.

The purpose of this book is to provide an elementary course in applied science for the woodworking trades to bridge over the gap between the abstract knowledge of the principles of science acquired by the average high school student and the practical application of these principles in industrial life. The book is a compilation of considerable generally known data, supplemented by knowledge gained through practical experience. Of particular interest to woodworkers are the chapters on trees, lumber, defects of wood. In addition the book treats in a clear and concise manner of woodworking tools and their uses, modern foundry methods, heating, ventilating, paints and varnishes, electricity and other subjects, which although not directly related to the woodwarking trades, are of value to anyone engaged in mechanical pursuits. A series of questions and problems at the end of each chapter serves to bring out the salient points of each subject and to test the student's power of concrete application of the principles set forth in the text.



Elevation of the Mikado Type and the Prairie Type from Which It Was Built

Changing Prairie Type to Mikado

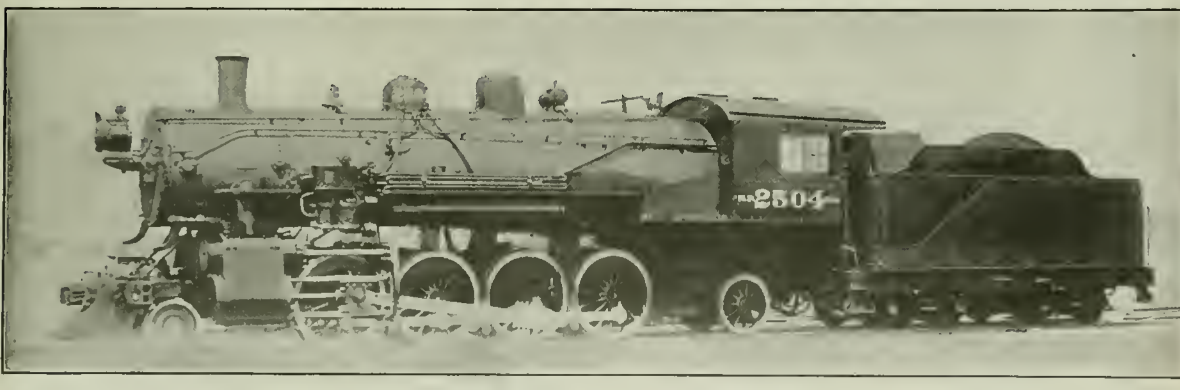
Redesigned Boiler Gives Higher Efficiency and Ample Steaming Capacity for Larger Cylinders

Among the equipment owned by the Northern Pacific there is a considerable number of locomotives of the Prairie type which were built about the year 1906. As these engines used saturated steam and had a rated tractive effort of 33,300 lb., they were not economical units for through freight service as regards either fuel or train loads. With a view to improving the performance of the engines and prolonging their period of usefulness, the operating department considered the advisability of converting them to the Mikado type. Plans were accordingly made in 1914, and six locomotives were changed at the Brainerd, Minn., shop in 1918 and 1919.

Northern Pacific Prairie Type Locomotive, Class T

The Prairie type locomotives had a total weight of 204,500 lb. and a tractive effort of 33,300 lb., while the Mikados weighed 249,000 lb. with 40,300 lb. tractive effort. In working out the alterations to be made, the original parts of the machinery and running gear were retained as far as possible. The addition of a fourth pair of driving wheels made new main frames necessary. The increased tractive effort desired called for larger cylinders and, to take care of the greater stresses, cast steel frames of larger section were designed. The engines as originally built had a short rigid wheel base, and the distance from the transverse center of the cylinder to the front axle was unusually short for locomotives of the Prairie type. It was, therefore, possible to keep the same dimension from the cylinder to the front driving wheel and also to retain the uniform spacing of 66 in. between the centers of the drivers. Since the weight per driving axle remained practically unchanged, no greater stresses were introduced in the equalizing system and the same springs, equalizers and hangers were used on the Mikado engine with the additional parts required to take care of the extra wheel. On both engines the equalizing system is divided between the second and third pair of drivers.

The cylinders on the Prairie type, or class T engine, were 21 in. by 28 in., but on the Mikado, or class W-4, they were enlarged to 24 in. by 28 in. with outside steam pipes. In order to provide for the greater piston thrust, the main axle was made 10 in. in diameter, but on the other wheels the original 9½ in. axle was retained. The piston rod was made 3½ in. longer and the main rod was shortened the same amount. As the position of the center line of the valve chamber was changed, a new rocker was made for the valve gear. The valve travel was also increased from 5 in. to 5½ in.



Mikado Type, Class W-4, Rebuilt from Class T

In changing the boiler the original barrel was retained, and a new front course and an enlarged smoke box were added. The increase in the length of the frame, as before mentioned, was 66 in. The space required for the superheater header made it necessary to set the front tube sheet

9 in. farther back from the center line of the stack. The remaining 57 in. was utilized by adding 39 in. to the length of the tubes, making them 16 ft. 6 in. long, and by increasing the length of the combustion chamber from 32 in. to 50 in. The brick arch was retained in its original position and no other change was made in the firebox. A superheater with 28 elements was added which, with the other changes, increased the equivalent heating surface from 2,359 sq. ft. to 3,186 sq. ft.

A comparison of the ratios of the class T and class W-4 is of particular interest in view of the restrictions placed on the design of the Mikado due to the necessity of conforming to many of the main dimensions of the Prairie type. The tractive effort was increased not in the same ratio as the weight on drivers but in the same ratio as the total weight, or about 21 per cent. The extension of the boiler barrel in a saturated engine would have increased the heating surface about 20 per cent, but with the addition of the superheater the equivalent heating surface was raised 35 per cent. The benefit of this change is shown by the decrease of the total weight per square foot of heating surface from 86.7 to 78.2 and the increase in the square feet of heating surface per cubic foot of cylinder volume from 210.6 to 217.9 square feet.

Excellent operating results have been secured with the new class W-4 engine. They have been placed in service on the division between Glendive and Billings, Montana, where the heaviest ruling grade westbound is 26 ft. per mile. In this direction the rating of the Prairie type is 1,600 tons, while the rating for the Mikado is 2,600 tons, an increase of 62 per cent. On the eastbound movement the length of the trains is controlled by the passing siding, and the ratings for the two types are as follows: From Billings to Forsyth, class T, 2,900 tons; class W-4, 3,400 tons; from Forsyth to Glendive, class T, 2,800 tons; class W-4, 3,300 tons.

The improvements in the smoke box were designed to overcome the trouble of throwing sparks. With the class T engines this has been very annoying in the past, particularly when used in the district where semi-bituminous coal is burned.

The converted engines ride much easier than the Prairie type and, because of the better load distribution, are much easier on the track.

An additional advantage secured by the conversion to the Mikado type is uniformity of train loads on several divisions. The heavier Mikados in use on the Northern Pacific have tractive efforts of 46,000 lb. and 57,100 lb. and, in conjunction with the class T and class W-4, provide motive power units adapted for hauling approximately equal tonnage on lines where the grades vary widely, thus facilitating through movement without breaking up trains at division points.

For the purpose of comparison the principal dimensions, weights and ratios for the two types of locomotives are as follows:

	Class T 6-3-2	Class W-4 2-8-2
General Data		
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Service	Freight	Freight
Fuel	Bit. coal	Bit. coal
Tractive effort	33,300 lb.	40,300 lb.
Weight in working order	204,500 lb.	249,000 lb.
Weight on drivers	153,500 lb.	204,000 lb.
Weight on leading truck	20,500 lb.	19,600 lb.
Weight on trailing truck	30,500 lb.	25,400 lb.
Weight of engine and tender in working order	353,000 lb.	397,500 lb.
Wheel base, driving	11 ft. 0 in.	16 ft. 6 in.
Wheel base, total	28 ft. 11 in.	34 ft. 5 in.
Wheel base, engine and tender	57 ft. 3½ in.	62 ft. 9½ in.
Ratios		
Weight on drivers ÷ tractive effort	4.61	5.06
Total weight ÷ tractive effort	6.14	6.18
Tractive effort × diam. drivers ÷ equivalent heating surface*	889.3	796.9
Equivalent heating surface* ÷ grate area	54.2	73.2
Firebox heating surface ÷ equivalent heating surface,* per cent	10.0	8.15
Weight on drivers ÷ equivalent heating surface*	65.1	64.0
Total weight ÷ equivalent heating surface*	86.7	78.2
Volume both cylinders	11.20 cu. ft.	14.62 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	210.6	217.9
Grate area ÷ vol. cylinders	3.88	2.98
Cylinders		
Kind	Simple	Simple
Diameter and stroke	21 in. by 28 in.	24 in. by 28 in.
Valves		
Kind	Piston	Piston
Diameter	12 in.	14 in.
Greatest travel	5 in.	5½ in.
Outside lap	1 in.	1 in.
Inside clearance	0 in.	0 in.
Lead in full gear	1/32 in. neg.	1/32 in.
Wheels		
Driving, diameter over tires	63 in.	63 in.
Driving, thickness of tires	3½ in.	3½ in.
Driving journals, main, diameter and length	9½ in. by 12 in.	10 in. by 12 in.
Driving journals, others, diameter and length	9½ in. by 12 in.	9½ in. by 12 in.
Engine truck wheels, diameter	33½ in.	33½ in.
Engine truck journals	6½ in. by 12 in.	6½ in. by 12 in.
Trailing truck wheels, diameter	45 in.	45 in.
Trailing truck journals	8 in. by 14 in.	8 in. by 12 in.
Boiler		
Style	Ext. Wagon Top.	Ext. Wag. top.
Working pressure	200 lb. per sq. in.	185 lb. per sq. in.
Outside diameter of first ring	72⅛ in.	70⅝ in.
Firebox, length and width	96 in. by 65¼ in.	96 in. by 65¼ in.
Firebox, plates, thickness	Door, crown and sides ⅜ in.; tubes ⅝ in.	Door, crown and sides ⅜ in. tubes ⅝ in.
Firebox, water space	Front 4½ in., back and sides 4 in.	4½ in. and 4 in.
Tubes, number and outside diameter	306-2 in.	173-2 in.
Flues, number and outside diameter		28-5⅜ in.
Tubes and flues, length	13 ft. 3 in.	16 ft. 6 in.
Heating surface, tubes and flues	2124 sq. ft.	2138 sq. ft.
Heating surface, firebox	235 sq. ft.	259 sq. ft.
Heating surface, total	2359 sq. ft.	2399 sq. ft.
Superheater heating surface		526 sq. ft.
Equivalent heating surface*	2359 sq. ft.	3186 sq. ft.
Grate area	43.5 sq. ft.	43.5 sq. ft.
Tender		
Tank	Rectangular	Rectangular
Journals, diameter and length	5½ in. by 10 in.	5½ in. by 10 in.
Water capacity	8 000 gal.	8000 gal.
Coal capacity	12 tons	12 tons

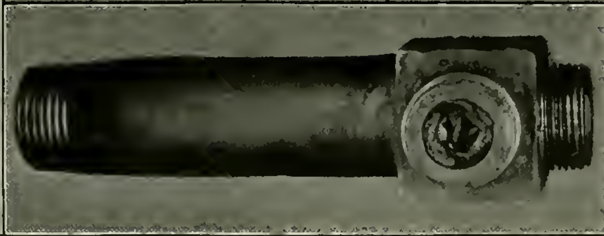
*Equivalent heating surface = total evaporative heating surface ÷ 1.5 times the superheating surface.

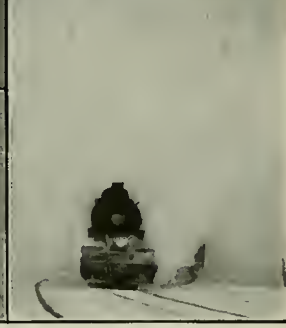
Photo Copyright by Kadel & Herbert.

An Unusual Ferry—Kiel, Germany

I. C. C. Locomotive Inspection Report

Disastrous Results of Low Water in Welded Fire-Boxes Blamed for Increase in Fatal Accidents





The eighth annual report of the chief inspector of the Bureau of Locomotive Inspection, which covers the year ending June 30, 1919, has recently been published. Tables I to IV show the number of locomotives inspected and the defects found. As the amendment to the boiler inspection law, extending its scope to include the entire locomotive and tender and all appurtenances, did not become effective until September 4, 1915, the record of the

Water Glass Cock Opening Almost Closed by Scale

fiscal year ended June 30, 1916, includes accidents and casualties for only nine months and 26 days.

Table I—Comparative Statement Showing Locomotives Inspected and Number Found Defective

	1919	1918	1917	1916
Number of locomotives inspected	59,772	41,611	47,542	52,650
Number found defective	34,557	22,196	25,909	24,685
Percentage found defective	58	53	54.5	47
Number ordered out of service	4,433	2,125	3,294	1,943
Total defects found	135,300	78,277	84,883	71,527

Table II—Number of Accidents, Number Killed and Number Injured

	1919	1918	1917	1916
Number of accidents	565	641	616	537
Decrease from previous year......per cent	11.8	[1]4.1	([2])	...
Number killed	57	46	62	38
Decrease from previous year......per cent	[1]23.9	25.8	([2])	...
Number injured	647	756	721	599
Decrease from previous year......per cent	14.4	[1]4.8	([2])	...

Table III—Accidents Due to Failure of Boilers and Appurtances Only

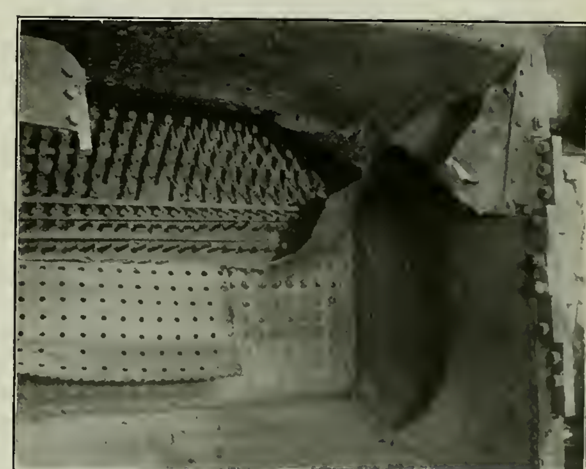
	1919	1918	1913	1912
Number of accidents	341	398	820	856
Decrease 1919 over 1918..........per cent	14.3	...	...	...
Decrease 1919 from 1912..........per cent	60.2	...	...	...
Number killed	45	36	36	91
Increase 1919 over 1918..........per cent	25	...	...	...
Decrease 1919 from 1912..........per cent	50.5	...	...	...
Number injured	413	510	911	1,005
Decrease 1919 from 1918..........per cent	19	...	...	...
Decrease 1919 from 1912..........per cent	58.9	...	...	...

A summary of all accidents and casualties occurring during the fiscal year ended June 30, 1919, covering the entire locomotive and tender and all of their appurtenances, shows

[1]Increase
[2]Percentage in decrease not shown for 1917, because of amended act not being in effect the entire year of 1916.

Table IV—Casualties Due to Failure of Locomotives, Tenders or Appurtances

	Year ended June 30—							
	1919		1918		1917		1916	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Members of train crew:								
Engineers	14	194	11	245	16	230	11	205
Firemen	22	265	19	306	21	304	12	225
Brakemen	11	82	6	62	13	60	9	74
Conductors	2	16	...	21	3	14	1	6
Switchmen	1	7	2	8	1	8	...	6
Roundhouse and shop employees:								
Boilermakers	1	9	...	11	...	11	1	11
Machinists	..	5	...	11	...	8	1	11
Foremen	..	3	1	4	...	1	1	3
Inspectors	.	6	4	4	...	3	...	3
Watchmen	..	2	...	3	...	5	...	8
Boilerwashers	..	7	1	4	...	7	...	10
Hostlers	..	6	...	8	...	6	...	6
Other roundhouse and shop employees	1	11	2	19	2	19	1	21
Other employees	3	23	..	26	5	22	...	7
Non-employees	2	11	.	24	1	23	1	3
Total	57	647	46	756	62	721	38	599



Result of Explosion Caused by Low Water. Welded Seam Between Crown and Side Sheets Gave Way

a decrease of 11.8 per cent in the number of accidents, an increase of 23.9 per cent in the number killed, with a decrease of 14.4 per cent in the number injured, as compared with the year ended June 30, 1918.

A summary of all accidents and casualties, caused by the failure of the locomotive boiler and its appurtenances only, for the fiscal year ended June 30, 1912, which was the first year of the existence of the law, compared with a summary of all accidents and personal injuries which occurred during the fiscal year ended June 30, 1919, shows the substantial decrease in the number of accidents, due to such failures, of 60.2 per cent; a decrease in the number of persons killed of 50.5 per cent, and decrease in the number injured of 58.9 per cent.

FAILURES OF AUTOGENOUS WELDS IN FIREBOXES.

It will be noted from Tables II and IV that the number of fatalities due to locomotive failures has not been reduced in proportion to the number of accidents. This fact is commented on as follows:

The increase in the number of persons killed during the last year, over the year previous, is, to a considerable extent, due to some very violent explosions which occurred because of fire box crown sheet failures, which serve to illustrate the prime importance of proper fire box construction, inspection and repair, together with the location, inspection and maintenance of such appliances as water glasses, gage cocks, injectors, steam gages and safety valves, upon which to a very great extent, rest the safety of locomotive boiler operation.

While some of these explosions were primarily caused by low water, it is believed that their violence and consequent results were greatly increased by failure of crown sheet seams which had been welded by the autogenous process. The failure of such seams, which have come into extensive use during the past few years, in most cases evidently caused the initial rupture and, in some cases, occurred with slight overheating.

Investigation of these accidents indicated that the failure of the welds occurred with a higher level of water in the boiler, and consequently a lower temperature in the sheet, than in other cases where the crown sheets failed and did not tear.

It will be recognized that the force of a boiler explosion depends upon the extent and suddenness of the initial rupture, together with the volume and temperature of the water in the boiler at the time of explosion. This feature is clearly brought out in the illustrations showing fireboxes which have failed in actual service.

It is true that not all autogenously welded fire box seams fail at the time of boiler explosion, but inasmuch as our records show that 80 per cent of all such welds involved have failed under such conditions, it is believed that, until

Dropped Crown Sheet Due to Low Water, Showing Failure of Welded Seam

some way has been discovered through which the quality and tenacity of a weld so made may be established in advance of its failure, fire box crown sheet seams so constructed should be avoided, where overheating and failure are liable to occur, and that autogenous welding should not be used where the strength of the structure is dependent upon the weld, nor where the strain, to which the structure is subjected, is not carried by other construction; nor in any part of a locomotive boiler wholly in tension while under working conditions.

It has been our purpose to co-operate with the United States Railroad Administration and the officials of the various carriers to the fullest extent consistent with our duties and the purpose of the law, and avoid as far as possible being compelled to order locomotives removed from service for unsafe conditions at a time when traffic might be seriously delayed. The fact that not a single formal appeal from the decision of any inspector, as provided for in section 6 of the law, has been filed during the fiscal year clearly demonstrates the wisdom and good judgment that has been exercised by them.

During the year, 198 applications were filed for an extension of time for the removal of flues, as provided for in rule 10. Investigation showed that, in 28 of these cases, the condition of the locomotives was such that no extension could properly be granted. Twenty-two were in such condition that the full extension requested could not be granted, but an extension for a shorter period within the limits of safety was allowed. Eleven extensions were granted after defects disclosed by our investigation had been repaired. Twenty-eight applications were withdrawn for various reasons, and the remaining 109 applications were granted for the full period as requested.

As provided in rule 54, there were filed 3,324 specification cards and 5,949 alteration reports. These were carefully checked in order to determine whether or not the boilers represented were so constructed as to be in safe and proper condition for service, and that the stresses given therein had been correctly calculated. The provisions of rule 2, by which all boilers are required to have a factor of safety to meet the requirement, has made necessary the strengthening of various parts of numerous boilers.

LOCOMOTIVE HEADLIGHTS

Substantial progress has been made in equipping locomotives with lights which will meet the requirements of the commission's orders of December 26, 1916, and December 17, 1917. The effective date of the commission's orders was fixed as of July 1, 1918.

Notwithstanding the strenuous oppositon offered by certain carriers to the promulgation of these requirements, these lights are meeting with the general approval of the employees who are employed where locomotives are so equipped; and the general expression is that "they are a great safety device." A number of the railroad officials, under whose jurisdiction these lights are being operated, have expressed their opinion that "they are economical and add materially to the safety of operation."

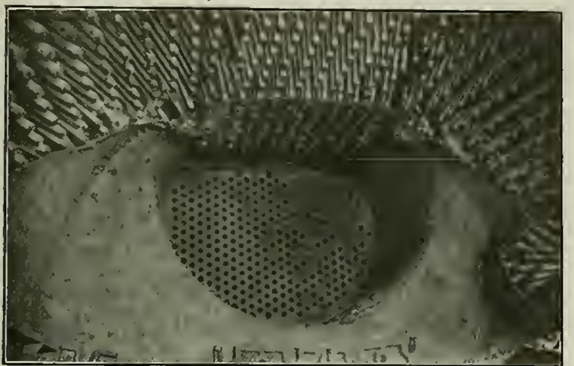
Under the order of the commission of April 7, 1919, certain modifications in the rules, which were granted in their order of September 20, 1917, because of conditions brought on by war, were abrogated, and others substituted. Experience had demonstrated that certain modifications, granted in the commission's order of September 20, 1917, could be made permanent, without adversely affecting the safety of operation; therefore, such modifications were retained in the permanent rules.

BOILER EXPLOSIONS

It is interesting to note that during the fiscal year ended June 30, 1912, there were 97 boiler explosions from all causes, resulting in the death of 81 persons and the serious injury of 209 others, while during the last year there were 67 explosions, resulting in the death of 39 persons and the serious injury of 112 others. These reductions amount to 30.9 per cent in the number of explosions, 51.8 per cent in the number killed, and 46.4 per cent in the number injured.

Attention is also directed to the fact that, since the inception of this bureau, 516 boiler explosions have occurred, resulting in the death of 277 persons and the serious injury of 889 others.

Five of these explosions, resulting in the death of 29 persons and serious injury of 50 others, were due to failure of shell sheets, caused by overpressure or defective sheets, which could have been detected and their failure avoided by proper inspection and repairs; 289, causing the death of 156 persons and the serious injury of 486 others, were due to failure of crown sheets, caused by low water, and where no contributory defects were found; 195, resulting in the death of 83 persons and the serious injury of 317 others, were due



Failure in Wootten Type Firebox Due to Low Water. Riveted Seam at Tube Sheet Intact, Welded Seam Failed

to failure of crown sheets caused by low water and where contributory defects, constituting violation of the law or rules, such as defective water glasses, gage cocks, injectors, broken stays or crown bolts, etc., were found; 22, causing the death of 4 persons and the serious injury of 31 others, were caused by failure of firebox sheets, due to defective or broken staybolts or crown stays; 5, causing the death of 5 persons and the serious injury of 5 others, were due to foaming of the water in the boiler, allowing the firebox sheets to become overheated.

Investigation showed that in 19 of the explosions which occurred during the last year, due to low water, defective water glasses and connections contributed to the cause of such failures, which fact clearly demonstrates again the importance of properly locating and maintaining such parts before placing boilers in service.

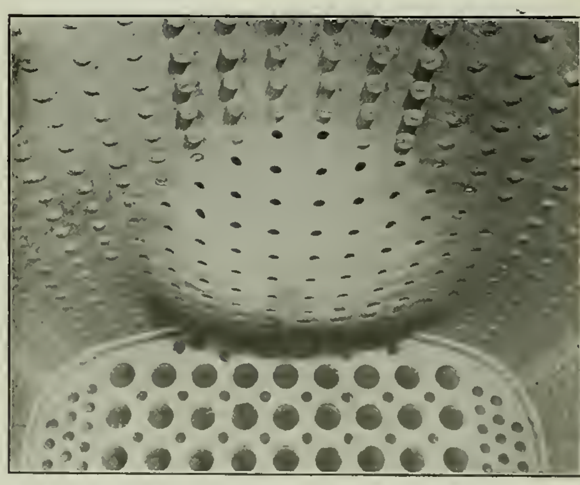
PRINCIPAL CAUSES OF ACCIDENTS

Our records show that during the past eight years, failure of squirt hose and their connections caused 976 accidents, resulting in the death of one person and the serious injury of 984 others; failure of 362 flues caused the death of three persons and the serious injury of 425 others; failure of 511 water glasses or their connections caused the death of one person and the serious injury of 515 others; failure of 148 grate-shaking appliances resulted in the death of one person and the serious injury of 147 others.

It is a physical impossibility for 50 inspectors to inspect at regular intervals and be familiar with the condition of any large percentage of 69,000 locomotives. The law places the responsibility for the general design, construction, and maintenance of all locomotives and tenders upon the carriers owning or operating them. It appears, however, that many officials and employees of the carriers, who are responsible for the inspection and repair of locomotives, have tried to evade this responsibility, and have, apparently, endeavored to transfer it to the federal inspectors, by allowing locomotives to remain in service with serious violations of the law and rules known to them, until our inspectors found them and caused the locomotives to be removed from service for needed repairs. The data shown in this report should impress the necessity of proper performance of duties upon those who are required to inspect and report defects on locomotives, as well as upon those who are responsible for the proper repair of such defects.

CHANGES RECOMMENDED

The following recommendations are made for the betterment of the service: First. That the act of February 17, 1911, be amended so as to provide for at least 50 additional inspectors. Second. That all locomotives not equipped with mechanical stokers or those using oil for fuel shall have a mechanically operated fire door, so constructed that it may be operated by pressure of the foot on a pedal, or other suitable device, located on the floor of the cab or tender at a proper distance from the fire door so that it may be conveniently operated by the person firing the locomotive. Third. That a power-reversing gear be applied to all locomotives and the air-operated power-reversing gear have a steam connection with the operating valves conveniently located in the cab, so arranged that, in case of air failure, steam may be quickly used to operate the reversing gear. Fourth. That a power grate shaker be applied to all coal-burning locomotives. Fifth. That all locomotives shall be provided with a bell, so arranged and maintained that it may be operated from the engineer's cab by hand and by power. Sixth. That cabs of all locomotives not equipped with front doors or windows of such size as to permit of easy exit shall have a suitable stirrup or other step and a horizontal handhold on each side, approximately the full length of the cab, which will enable the enginemen to go from the cab to the running board in front of it—handholds and steps or stirrups to be securely attached with bolts or rivets; the distance between



Typical Bagged Crown Sheet in a Firebox with Riveted Seams

the step and handhold to be not less than 60 in. nor more than 72 in.

In conclusion the report recommends that these appliances should be applied to all new locomotives before they are placed in service, that locomotives now in service without such appliances should be so equipped the first time they pass through the shop for classified repairs, as specified by the United States Railroad Administration, and all locomotives in service should be so equipped within a reasonable time.

CONVERTING CROSS COMPOUND LOCOMOTIVES TO SIMPLE

During the years 1905 and 1906 the Minneapolis, St. Paul & Sault Ste. Marie purchased a considerable number of cross-compound locomtives of the Consolidation type. These engines were among the heaviest of their class at the time they were built, the total weight in working order being 101 tons. At the present time they are still used in through freight service and in order to eliminate the unsatisfactory features of the compound, one of the class was recently converted into a simple locomotive using superheated steam. Tests conducted to determine the relative fuel consumption of the compound and the simple superheated engine showed that the change in the design resulted in a substantial saving of fuel.

For the purpose of the test two engines were chosen which were in practically the same mechanical condition. Engine 448 was a cross-compound, while engine 468 was superheated with simple cylinders. One engine crew was assigned to the test and was used on all the runs. In order to obtain a close check on the fuel used, approximately the correct amount of coal for the run was weighed and put into the coal space of the tender. An additional supply was weighed out into 100-lb. sacks and was carried on the back of the tender. The fuel used in firing up and before the test started was taken from the sacks and accounted for separately. After the main supply had been burned, sacked coal was used or in case the pit was not emptied, the remainder was removed and weighed. A record of the water used was made by means of a gage each time the tank was filled.

The division on which the test trains were run extends from Moose Lake to Boylston Junction, Minn., a distance of 38 miles. The regular tonnage for the cross-compound locomotives is 90 cars or 1,440 tons and the majority of the trips were made with this tonnage. On two trips with the superheated simple engine, the train was increased to 100 cars of 1,600 tons. Although the increase in the rated tractive effort of the simple over the cross-compound is only six per cent. these runs showed that engine 468 would handle 100 cars better than engine 448 would handle 90 cars. On hauls out of the ore mines, the regular rating for the compounds is 50 cars, but on test trips engine 468 hauled 55, 59 and 60 cars without any difficulty. Another trial run was made from Superior, Minn., to Glenwood, a distance of 200 miles. On this division the tonnage rating for the cross-compound engine is 2,200 tons, but in order to make the trip in less than 16 hours the train must be reduced to from 1,800 to 2,000. With engine 468 a train of 2,157 tons was hauled from Superior to Glenwood in 10 hrs. 7 min. actual running time, making an average speed of nearly 20 miles an hour.

The fuel performance with the two engines on the trips between Boylston Junction and Moose Lake are summarized in the accompanying table.

Engine No.	Test No.	No. of cars	Tonnage	Coal per 1,000 ton miles	Decrease for Engine 468 per cent	Coal per sq. ft. of grate per hour	Actual Evap. per lb. coal	Running time
468	1 and 2	90	1,440	124	13.9	78.0	6.93	1 h 32m
448	5 and 6	90	1,440	144	...	56.5	7.78	2 h 37m
468	3 and 4	100	1,600	128	...	80.0	6.96	1 h 52m

It will be noted that the actual evaporation per pound of coal with the superheated locomotive was 10.9 per cent less than with the saturated locomotive, due no doubt to the reduction in tube heating surface resulting from the application of the superheater. In spite of this, the superheated engine used 13.9 per cent less coal per 1,000 ton miles than the compound saturated engine.

The principal dimensions, weights, and ratios for the original and the converted locomotives are given below:

General Data

	Engine 448 (Cross-compound)	Engine 468 (Simple superheated)
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Service	Freight	Freight
Fuel	Bit. coal	Bit. coal
Tractive effort	37,300 lb.	39,500 lb.
Weight in working order	201,500 lb.	197,800 lb.
Weight on drivers	174,000 lb.	169,800 lb.
Weight on leading truck	27,500 lb.	28,000 lb.
Weight of engine and tender in working order	318,400 lb.	314,700 lb.
Wheel base, driving	17 ft. 0 in.	17 ft. 0 in.
Wheel base, total	25 ft. 11 in.	25 ft. 11 in.
Wheel base, engine and tender	55 ft. 9½ in.	55 ft. 9½ in.
Ratios		
Weight on drivers ÷ tractive effort	4.67	4.30
Total weight ÷ tractive effort	5.40	5.01
Tractive effort × diam. drivers ÷ equivalent heating surface*	811.2	909.2
Equivalent heating surface* ÷ grate area	61.8	58.4
Firebox heating surface ÷ equivalent heating surface,* per cent	5.45	5.77
Weight on drivers ÷ equivalent heating surface*	60.1	62.0
Total weight ÷ equivalent heating surface*	69.6	72.3
Volume equivalent simple cylinders	11.45 cu. ft.	......
Volume both cylinders	15.65 cu. in.	......
Equivalent heating surface* ÷ vol. cylinders	252.8	174.9
Grate area ÷ vol. cylinders	4.08	3.00
Cylinders		
Kind	Cross-compound	Simple
Diameter and stroke	23 in and 35 in. by 34 in.	22½ in. by 34 in.
Valves		
Kind	H. p. cyl., piston; L. p. cyl., slide	Piston
Diameter	......	12. in.
Greatest travel	6 in.	6 in.
Wheels		
Driving, diameter over tires	63 in.	63 in.
Driving, thickness of tires	3½ in	3½ in.
Boiler		
Style	Ext. wagon top	327 sq. ft.
Working pressure	210 lb. per sq. in.	2,737 sq. ft.
Outside diameter of first ring	67⅜ in.	Ext. wagon top
Firebox, length and width	96⅛ in. by 70¼ in.	170 lb. per sq. in. 67⅜ in.
Tubes, number and outside diameter	332-2 in.	96⅛ in. by
Flues, number and outside diameter	......	70¼ in.
Tubes and flues, length	15 ft. 9 in.	178-2 in.
Heating surface, tubes and flues	2,739 sq. ft.	28-5⅜ in.
Heating surface, firebox	158 sq. ft.	15 ft. 9 in.
Heating surface, total	2,897 sq. ft.	2,089 sq. ft.
Superheater heating surface	......	158 sq. ft.
Equivalent heating surface*	2,897 sq. ft.	2,247 sq. ft.
Grate area	46.89 sq. ft.	46.89 sq. ft.

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

A New Means of Cooling Pistons.—A recent British invention has been made whereby the piston of an internal-combustion engine may be cooled by means of a draft of air circulating through a space in the piston. The draft is provided by means of fan blades on the engine flywheel. On either side of the hollow piston are ports which register with corresponding ports in the cylinder walls at the end of the stroke. A draft of air is thus forced through the hollow space in the piston while all the ports are in line.—*Compressed Air Magazine.*

The High Cost of Tool Breakage.—A complete record of total breakage kept by a far western American steel company shows convincingly the expense of putting good tools in the hands of careless or incompetent workmen and indicates that it is particularly heavy when numbers of new men are being put to work. Even in normal times the company found that the damage in tools is a big problem and it actually happened on one or two occasions that careless men destroyed in a moment tools far in excess of the value of their labor for weeks and months. Before labor turnover became a problem last fall, two tool room clerks with eight assistants easily dispensed the equipment required by 500 men, whereas toward the end of the year 39 were required and 11 men were engaged solely on grinding the tools.—*Scientific American.*

The Deflection of Staybolts

Movement of Sheets of Locomotive Fireboxes; Relative Action of Rigid and Flexible Bolts

BY GEORGE L. FOWLER

For many years the breakage of staybolts in locomotive boilers has been a source of danger and this danger was emphasized very soon after the locomotive took its rapid leap ahead in size when it was found that it was no longer necessary to limit firebox dimensions to the space available between the driving axles and the frames.

The increase in the length of fireboxes caused a corresponding increase in staybolt breakages. It was assumed that this breakage was caused by the bending of the staybolts due to a variation in the expansion of the two sheets which they connected, by which they were strained beyond their elastic

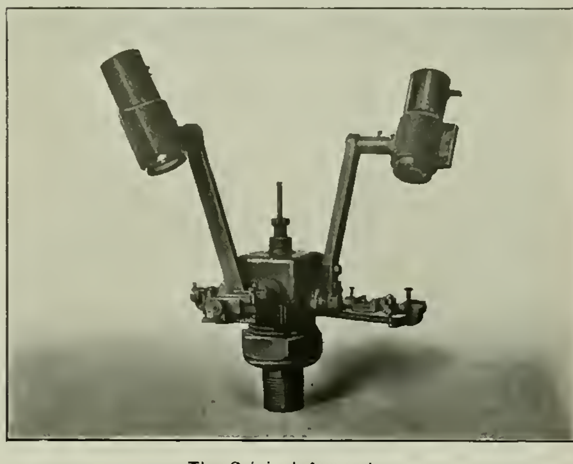
Screen for Recording the Movement of the Beams of Light Reflected by the Mirrors

limits, thus producing a progressive fracture. It was also assumed when the boiler was working under normal conditions that staybolts were straight in their normal position and were subjected only to that stress which would be imposed upon them by the steam pressure acting upon the plates. It was further assumed that the deflection of the bolts occurred during the process of raising steam, and that, because the breakage occurred at the ends of the firebox, there was a neutral vertical zone at the longitudinal center of the firebox along which there was no staybolt deflection. But, while assumptions and theories were as plentiful as autumn leaves, there was no data on the subject and no one knew. The most that had been done, in the way of investigation, was to determine that, under certain conditions, there was an upward and downward movement of the crown-sheet and the tubes.

The object of the investigation described in this article was to determine, by actual measurement, the amount of relative movement between the inner and outer sheets of a locomotive firebox and also when that motion occurred as well as its general character. There was no precedent upon which to proceed nor any thing more than the vaguest of guesses as to the amount of motion to be looked for—except that probably it would be very slight.

The apparatus used was of a very simple character and involved only one moving part. Its work consisted of resolving the motion of the inner sheet relatively to the outer one, into its vertical and horizontal components and projecting them on a screen. These were afterwards recombined to plot this relative movement in the form of a diagram. The mechanism of the apparatus consisted of two small metallic mirrors that were first adjusted to a perfect parallel. A beam of light from a narrow slit was reflected back to a screen. One mirror was fastened rigidly to the outer sheet and traveled with it and remained parallel to it at all times. The main body of the apparatus including all lenses and adjustments was also attached to this same sheet. The second mirror was suspended on the main body of the apparatus but was so connected to the inner sheet that, if any motion took place between the two sheets, the mirror would be rotated. This would cause a separation of the two beams of light on the screen and the amount of separation was a measure of the relative movement of the sheets. The calculation of the motion was simply dependent upon the distance at which the screen was set from the mirrors.

The first setting was such that separation of 1/16 in. indicated a relative movement of 1/20,000 in. between the two plates. This was found to give finer measurements than were needed and the whole of the work, hereinafter detailed, was done with the screen so set that each 1/16 in. separation



The Original Apparatus

of the beams of light indicated a relative movement of 1/6400 in. between the plates.

The first boilers subjected to investigation were of the radial stayed type as illustrated in the accompanying engravings. There were two of them that were identical in construction except that one was fitted with a complete installation of the ordinary rigid staybolts and the other with a complete installation of the Tate flexible staybolts.

The firebox dimensions were:

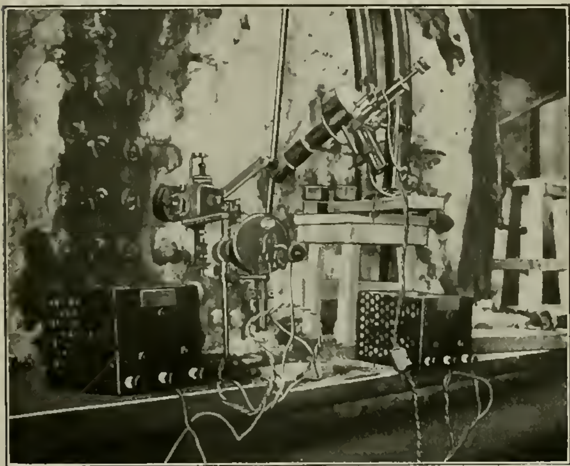
Length at bottom	8 ft. 3 in.
Length at top	8 ft. 8½ in.
Width at bottom	5 ft. 2 in.
Width at top	4 ft. 8 in.

The general arrangement of the apparatus is shown in the illustrations. Each firebox was fitted with four water tubes for carrying a brick arch which was located as shown.

New fireboxes had been placed in each of the boilers immediately prior to the tests so that all of the sheets affected were fresh and clean.

SCOPE OF INVESTIGATION

The scope of the investigation was as follows: Determination of the difference in the movement of the inner and outer side sheets of the firebox at eight points; the difference in movement of the crownsheet relatively to the roofsheet; of the back firebox sheet relatively to the back head; of the throat sheet relatively to the front tubesheet and of the front tubesheet relatively to the shell. Determination of the temperature of the fire and water sides of the inner firebox sheet at the side at five points; the water temperatures in the throat at the foundation ring and in front of the arch tube openings, while steam was being raised in the boiler and while it was at work.



The Original Apparatus Applied to a Radially Stayed Boiler

Two methods of conducting the tests were employed. In one the fire was kindled and the fireman instructed to raise steam in the manner usual in regular roundhouse work. When the safety valve opened, the fire was maintained so as to keep the valve blowing for from 10 to 20 minutes, when the fire was dumped and the boiler allowed to cool. The time required to raise the steam pressure to the blowing off point varied from 50 to 90 minutes.

The second method was the same as the first insofar as the raising of steam pressure is concerned; but, when this was done, the distribution valves having been removed from the locomotive, the throttle was opened and, with the injector running to capacity, the fire was maintained so as to hold the steam pressure at the blowing-off point—195 lb.—for about 30 minutes and then the fire was dumped and the boiler cooled.

In raising steam the shop blower, carrying a pressure of about 60 lb. per sq. in., was attached to the locomotive and used until the boiler pressure reached that amount, after which the regular locomotive blowers were used.

In cooling the boiler steam was blown out so as to cause a fall of pressure of about 1 lb. per min., taking about three hours to reduce the pressure to zero.

In making the tests the apparatus was successively located at the staybolts marked 1, 2, 3, 4, 5, 6, 7 and 8.

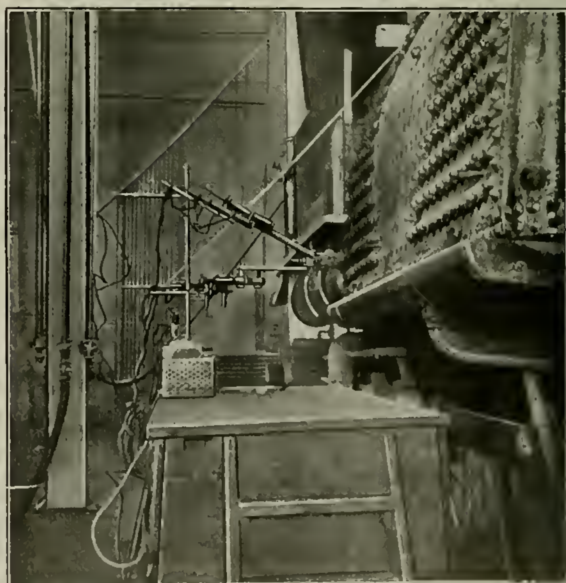
Lack of space will make it impossible to enter into the details of all of the work done, and only enough of it will be described to give an idea of what was learned and the basis for the tentative conclusions that have been reached. I say "tentative" because the investigation has not yet been completed and full information is not available as to how all kinds of fireboxes act in service. The reasons for this will appear as the description proceeds.

In the tests at staybolt No. 1, which was at the front upper corner of the firebox, the first method of testing was used, and the results obtained are shown in the diagram. In this, as in all diagrams to follow, the scale of movement is in thousandths of an inch, on either side, vertically or horizontally, of the starting point at O which denotes the normal position of the two sheets when the boiler was cold at the commencement of the test.

In the first test at staybolt No. 1, it will be noticed that the initial movement of the inner sheet relatively to the outer one was downward and to the rear, and it will be seen later that this initial downward movement was characteristic of nearly all of the tests. Both the downward and rearward movements were, however, quickly reversed and the inner sheet moved up and to the front.

There are features brought out in this diagram that are characteristic of all of the others and to which attention may be called here. One is that the sheets do not expand and return to their normal position when a steam pressure is raised; a second that the sheets are in constant motion relatively to each other at all times, and that the relative motion is much greater with a boiler fitted with flexible stays than it is with one having rigid stays.

In the case of staybolt No. 1, this difference in movement

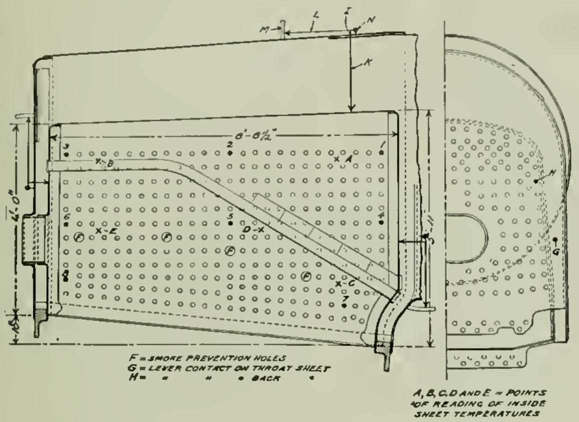


The Redesigned Apparatus Applied to a Boiler Having a Wootten Firebox

is very marked and the total maximum deflection of the flexibly stayed boiler is more than twice that of the rigidly stayed. If the variation of vertical movement alone is taken into consideration, that of the flexibly stayed boiler is more than five times as great as that of the rigidly stayed. It will be seen, too, that there is a general progressive movement until the blowing-off pressure is reached, then, while that is being maintained, there was a movement of the sheets to and fro, with a general return movement towards the original normal position after the fire was dumped and until the boiler had been cooled to the disappearance of all pressure.

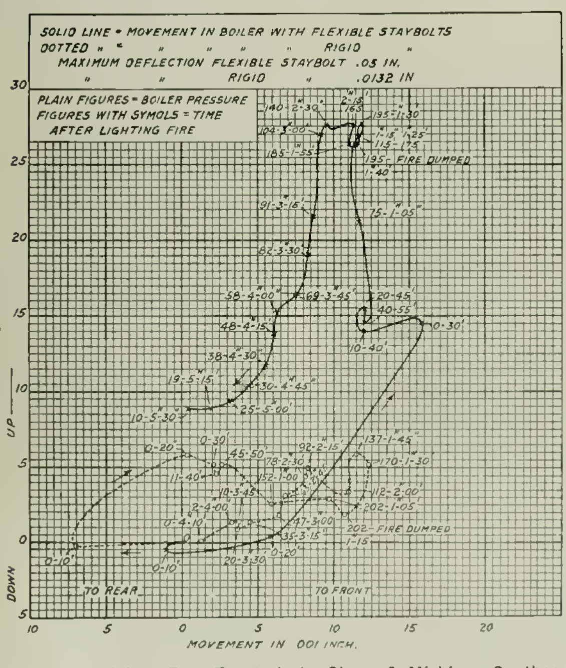
In this first diagram, the rigidly stayed sheet returned to within about .001 in. of its original position, while the flexibly stayed sheet was out about .009 in. at the conclusion of the test.

Owing to the fact that, in rigidly stayed boilers, the breakage at the upper front and back corners of the side sheet was much greater than it was midway between the two, it has been assumed that there was a neutral point on this midway



Arrangement of Firebox in Lake Shore & Michigan Southern Locomotive for Temperature and Expansion Tests

line, on which the staybolt deflection was little or nothing. That this surmise was approximately correct is shown by the diagram of the tests made at staybolt No. 2 which was at the center of the upper row. Here, in both the flexibly and rigidly stayed boiler, we find that the horizontal motion was



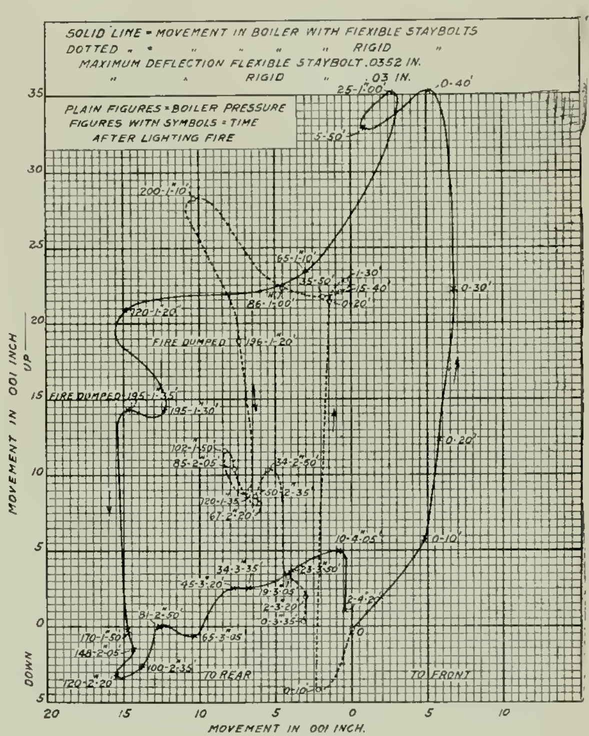
Staybolt No. 1 Top Row Front—Lake Shore & Michigan Southern Locomotive

much less than the vertical, indicating an approach to a neutral zone, but, as at staybolt No. 1, we find the horizontal movement of the sheet to be something more than twice as much on the flexible as on the rigidly stayed boiler.

It is impossible to state positively that there is no neutral line with the rigid boiler, but the statement can be made regarding the flexibly stayed boiler. Of course, if the front end of the inner sheet goes to the front and the back end to the rear there is, possibly, an instantaneous neutral line, but it must be in constant motion and, therefore, does not fulfil the preconceived ideas as to the neutral line.

From a study of the curves of movement of the staybolts examined on the rigidly stayed boiler, the evidence is that the same holds true for that boiler, namely, that the point of no movement—that is, where the two sheets occupy their original or normal positions—is in constant motion. This means that all staybolts are being constantly bent back and forth, which is corroborated by the determination of sheet temperatures which formed a part of this investigation.

In the case of staybolt No. 3, which was at the back end



Staybolt No. 2 Top Row Center—Lake Shore & Michigan Southern Locomotive

of the top row and close to the back head, there was a sudden and rapid movement of the inner sheet to the rear on both rigidly and flexibly stayed boilers, and the maximum of the horizontal movement was reached in a very short time after the kindling of the fire; the rigidly stayed boiler reaching it in 10 and the flexibly stayed in 20 minutes.

Without going into details of the other tests, it may be stated that while the amount of movement varied, the character of the motion did not vary essentially and the same relationship between the rigidly and the flexibly stayed boilers was maintained.

When tests were made at the next to the bottom row of staybolts, however, a matter developed that proved to be of very great importance. Attention has already been called to the fact that in the test at staybolt No. 1, the first apparent motion of the sheet was downward, but as this only amounted to .00075 in. it was regarded as a negligible quantity. At the bolt below it, (No. 4,) there was a drop of .00225 in. which was still not enough to excite suspicion, but at No. 7 this drop increased to .009 in., apparently indicating a downward movement of the inner sheet at a point only a few inches above where it was riveted to the mud ring. Evidently this is an impossibility, and the only explanation to be made was that the sheet had buckled and, by throwing the apparatus out of line, caused it to indicate a downward movement.

These first tests therefore must be regarded as showing but two things: the constant movement of the staybolts while in service and the relative movement of the sheets of a rigidly and flexibly stayed boiler.

With no precedent to serve as guide, the apparatus had been designed on the assumption that the two sheets would remain parallel to each other at all times. When this evident buckling was discovered the apparatus was redesigned so as to indicate not only the movement of the sheets but any buckling that might take place.

This redesigned apparatus was used on some boilers having a Wootten firebox with general dimensions as follows:

Length	10 ft. 1 in.
Width at foundation ring	8 ft. 11¾ in.
Height at front	5 ft. 8 in.
Height at back	5 ft. 1½ in.
Depth of combustion chamber	5¼ in.
Number of 2 in. tubes	411
Length of tubes	14 ft. 6 in.
Inside diameter of shell (front)	6 ft. 1 in.
Height of roof over crown (front)	1 ft. 6¾ in.
Height of roof over crown (rear)	1 ft. 9½ in.

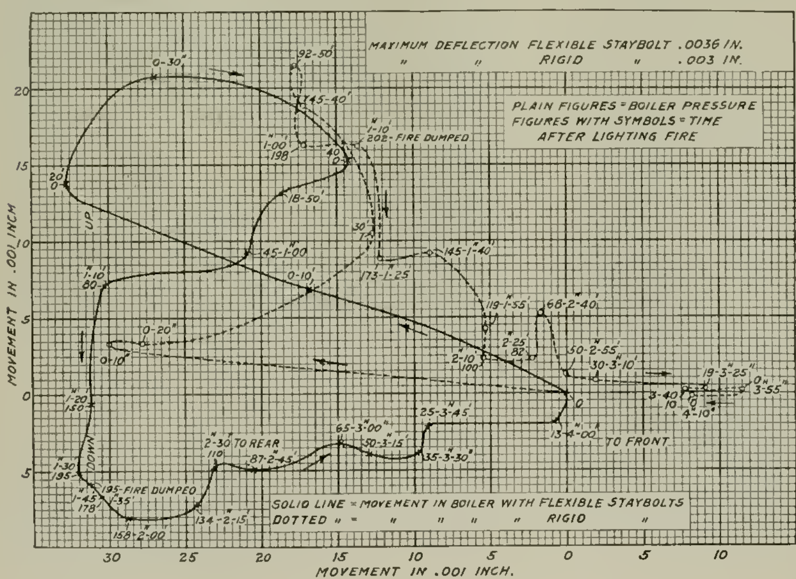
There were three rows of expansion stays at the front to hold the crown sheet and eight on each side of the center line as shown in the drawing. The staybolts were spaced on four in. centers and the rigid bolts were ⅞ in. in diameter.

The two boilers were not as distinctly flexibly and rigidly stayed as were those used in the first tests. The boiler which has been designated as the rigidly stayed had a number of Tate flexible staybolts as indicated in the drawing. In the throat sheet all of the bolts in the seven upper rows and all of the bolts in the outer row, were flexible. In the side sheets there were 15 Tate flexible bolts in the front row, and 12 other scattering Tate bolts that had been put in for repairs, in the locations shown in the drawing.

The other boiler, which is designated as the flexibly stayed boiler, had a complete installation of flexible bolts in the throat sheet, with the exception of 20 bolts near the foundation ring that were rigid as shown in the drawing. Of a total of 510 staybolts in the side sheet, 248 were flexible bolts. These were located in equal numbers and with the same arrangement at the front and back end of the firebox. There were six in the top horizontal row next to the crown sheet, with a gradual increase from the top to the bottom as shown in the drawing and the photograph. This left a wide section of firebox at the center that was stayed by rigid bolts and which, evidently, exerted an important influence on the results as will be pointed out later.

The staybolts at which these tests were made were located at the numbered points 1 to 9 on the two drawings, and the tests were made as before, by raising steam, holding the throttle open for 30 minutes and then blowing down at the rate of 1 lb. per min., readings of the sheet movements having been made during the whole period at 10-minute intervals.

Whether it is because the apparatus used on the radially stayed boilers only indicated the apparent motion of the sheets while that used on the Wootten boilers indicated the actual movement, that the diagrams of these movements are much more complicated for the latter boilers cannot be stated positively. That the buckling that evidently did occur in the sheet of the radially stayed boilers had its effect on the actual movement of the sheets is a reasonable supposition, but certainly there is a great difference in the character of the two.



Staybolt No. 3 Top Row Back—Lake Shore & Michigan Southern Locomotive

COMPARISON OF TWO TYPES OF BOILERS

Let us compare those for staybolts No. 1, in the two types of boilers: In the radial stayed boilers there is a steady even motion of the sheet with little or no doubling back and looping over itself. There was a constant movement, but it was, in the main, a progressive movement ending with an apparent deflection of about .008 in. from the starting point of the flexibly stayed boiler.

The rigidly stayed boiler was a little more complicated in its motion, but still not at all confusing, and ended with a deflection of a little more than .001 in. from the starting point.

The diagram for the corresponding staybolt of the Wootten boiler is a mass of knots and loops and back doubling. This is especially true of the period prior to the development of the first steam pressure. This appeared at the point marked O-2H-10′ in the diagram when steam began escaping from the whistle valve. Then there was a rapid upward movement for 20 minutes until a pressure of 75 lb. was reached followed by an equally rapid forward and downward movement during a quick building up of the pressure to 200 lb. Then came a quick recovery horizontally during the period that the throttle was open with only a very slight change in vertical position between the beginning and the end.

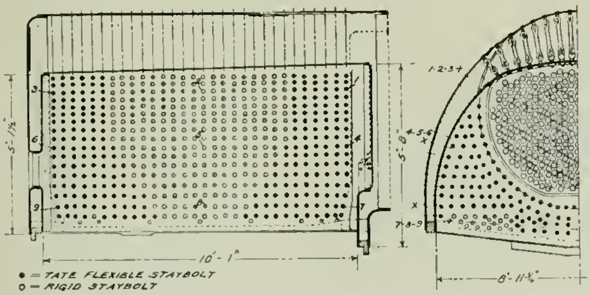
This movement is easily explicable if the tube action as indicated by other tests is taken into consideration. It was found that during the early period of raising steam the tubes were heated more rapidly than the shell with the result that the back tube sheet and with it, probably, the front end of the firebox was pushed to the rear. This explains the slight rearward movement of the staybolt at the starting of the test. Then, as the water became heated there was a tending toward equalization of the temperatures of the tubes and the shell. This resulted in a relative forward movement of the tube sheet permitting the firebox to expand normally. Then, when the throttle was opened, there was a rapid increase of firebox temperature resulting in a corresponding increase in the temperature of the gases in the tubes themselves, which again pushed the tubesheet to the rear carrying the front end of the firebox with it. Then followed the looping and doubling of the movement during the cooling down, ending with the staybolt a little more than .002 in. from its original position.

In the rigidly stayed boiler the entanglement of the line of the movement is equally marked and is of the same general character, but, as in the other cases, the extent of the movement is much less.

This condition holds throughout the whole range of the work, varying in extent with the location of the staybolt and the method of staying. In general the movement was greater at the ends and upper portions of the firebox than at the center and lower portions.

There is another matter in connection with the rigidly stayed boilers that does not fully appear in the diagrams: The evident reason for the lesser deflection of the rigidly stayed boiler is that it is rigid. The staybolts tend to hold the sheets in one position and resist all tendency to move, and this manifests itself in the jerky character of such motion as takes place. That is to say, there are sudden variations in the distance from the original position which indicate that the stays resist the effect of the expansion of the sheet to move them, possibly buckling the sheet, and then when the pressure becomes more than they can carry, they suddenly yield.

The one point where a close comparison and check between the radially stayed and Wootten type is possible is in the movement of the staybolts when the boiler is in service. In both cases it was found that the sheets were in constant motion relatively to each other from the instant the fire was built until the boiler was cold. Also the extent



Delaware & Hudson Locomotive No. 813 with Flexibly Stayed Wooten Firebox

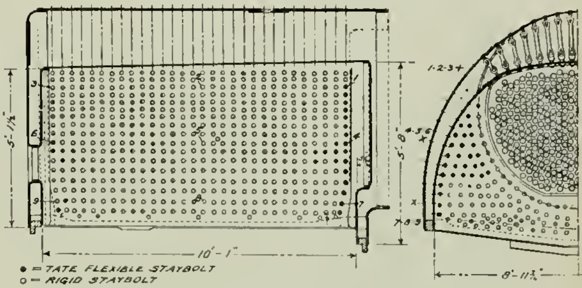
of the movement was much greater in the flexibly stayed boiler than in the rigidly stayed.

The character of the movement was, however, apparently quite different in the two types of boilers. There was more bending to and fro in the Wootten as well as a much greater movement. This is especially manifest in staybolt No. 1, where the maximum deflection of the flexible bolt in the Wootten type was about nine times that of the radially stayed, and this amount entirely in a vertical direction.

There may have been several reasons for this. The Wootten firebox was 1 ft. 4½ in. longer and 1 ft. 1½ in. deeper and the staybolt was 8 in. long as against 5¾ in. for the radially stayed boiler. Each of these items would tend to increase the deflection, while the comparatively small amount of horizontal deflection is explicable from the fact that there was a complete installation of flexible bolts in the radially stayed boiler, while, in the Wootten type there was a line of 18 rigid bolts in the central section that tended to stiffen the boiler and prevent a relative movement of the sheets. These are suggested as reasons, not as demonstrated proofs.

The main fact, however, stands out very prominently that the character and amount of the staybolt deflection is quite different in the two boilers. As yet, there is not sufficient data accumulated to be able to state definitely as to just why this is so, and what should be done to the general design of one or both of the boilers to put the least possible strain on each.

In the matter of the buckling of the sheets caused by the



Delaware & Hudson Locomotive No. 794 with Rigidly Stayed Wooten Firebox

combined action of sheet expansion and resultant staybolt deflection, it was found that the buckling was greater with the flexible than with the rigid bolts; but, it must be borne in mind that the deflection was also greater, and a study of the details shows that the ratio of the buckling of the flexibly stayed to the rigidly stayed was less than the corresponding ratio of deflection. In other words, given a fixed amount of staybolt deflection the buckle put in the sheet would be less with a flexible than with a rigid staybolt.

While at work on the rigidly stayed boiler having the Wootten firebox an attachment was made in the space just ahead of the No. 5 staybolt. As might have been expected, the actual movement of the sheet was about the same as at the No. 5 staybolt but there was less buckling. This developed the probability that, in this long and wide firebox at least, the whole sheet, while under steam pressure, assumes a series of shallow corrugations that hold it out of alinement with its original shape, and which are sweeping over it in waves, as it were, according as the sheet expands or contracts. The depth of the corrugations is slight and the angle made by the sides of the same with the original line of the sheet is never as much as one degree. The greatest angle obtained on the Wootten type was 48 minutes 52 seconds with a general average for all points tested on the flexibly stayed boiler of 7 minutes 29 seconds.

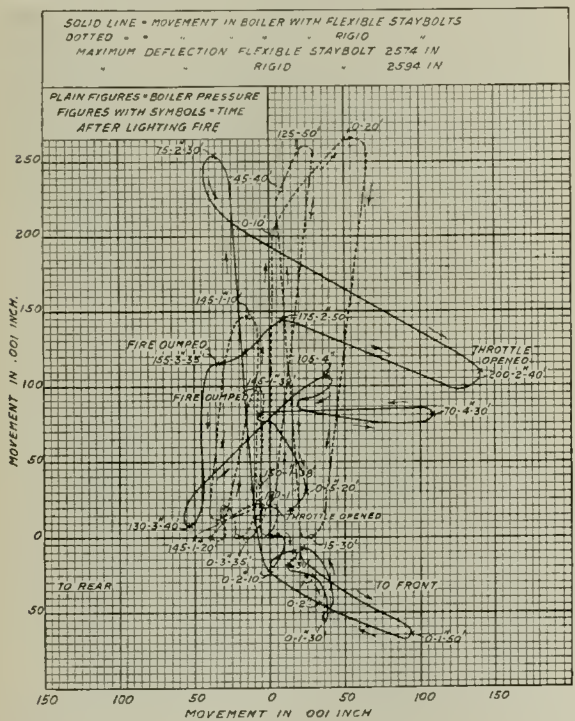
It is also possible that the buckling of the sheet might be appreciably decreased by a change in the original adjustment of the flexible staybolts, and also that there might be an increase in the deflection of the bolts. The suggested methods of accomplishing this is to give a little more play in the head of the bolt and the allowing of a little slack under the heads in the first place. This would permit of an easier adjustment to the movement of the sheet during the period of raising steam, when there is no load on the bolt, and the allowance of a little freedom of angular motion when the sheet and bolt are under strain.

Other matters were taken up in connection with this investigation for which there is no space to deal at this time. There were the effects of cold air in the firebox on sheet temperature and the lack of circulation in the water leg.

CONCLUSIONS

The fundamental facts fully brought out were that the staybolt deflection is much greater in a flexibly stayed boiler than in a rigidly stayed boiler, that certainly during the whole period of operation and probably until the boiler temperature had reached that of the atmosphere the staybolt is in constant motion as evidenced by the fact that, out of the hundreds of measurements taken, there were no two consecutive measurements alike; that the two types of boiler construction (Wootten and radially stayed) have quite different effects on staybolt deflection; and that firebox temperatures and the action of the tubes have a marked influence on staybolt deflection at the front end of the firebox.

These tests also showed in a marked degree the extreme



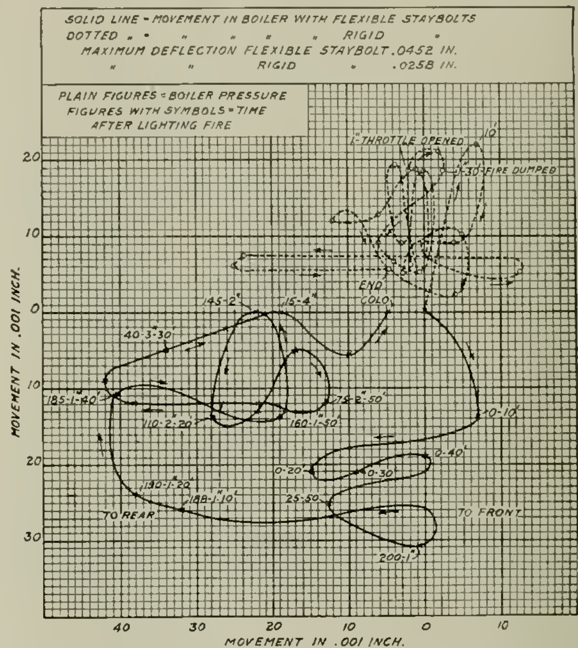
Staybolt No. 1 Top Row Front—Delaware & Hudson Locomotive

sensitiveness of the plates to changes of temperature. For example, a cold boiler may be filled with water of any temperature from cold to boiling and there will be no relative motion between the sheets. But let the fire be laid and a piece of lighted waste thrown in to ignite it, and it has, thus far, been impossible to get a reading before the sheets would show a movement, though this has been done within ten seconds from the time of the ignition of the waste.

This investigation is merely indicative and not conclusive. The absence of any data upon which to estimate the probable movement and buckling of the sheets made a redesigning of the apparatus necessary, and the use of boilers with a mixed assortment of staybolts in the second case, gave results that would probably be greatly modified were boilers with complete installations to be used. But there is this indication, that the boiler will expand and the staybolts deflect if they have a chance, and that this chance is much greater with a flexible bolt than it is with a rigid one.

As has already been intimated, the difference in the conditions of operation of the apparatus makes a clean-cut comparison between the Wootten type and the wide firebox radially stayed boiler impossible. But the impression left by the test is that the Wootten firebox is much more rigid than the wide firebox when rigidly stayed with the radial stays, and that if it were given a complete installation of flexible bolts the difference between the two would be very much greater than that indicated in these tests.

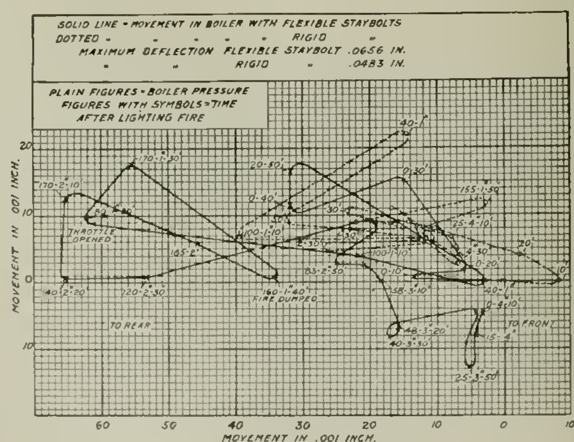
In every case the extreme sensitiveness of the sheets to



Staybolt No. 2 Top Row Center—Delaware & Hudson Locomotive

any changes of firebox temperature was noted. This fully explains the constant bending motion to which the bolts are subjected while the boiler is at work.

It naturally follows from this that a boiler which is so



Staybolt No. 3 Top Row Back—Delaware & Hudson Locomotive

built as to permit the sheets to expand under the influence of temperature changes, will put less stress upon the staybolts and sheets than one where such freedom of motion does not exist. There is no reason to think that there was any great difference in the temperatures of the sheets of the two boilers, and yet, as I have already indicated, there was a marked difference in the movements of the staybolts and the sheets. If a given change of temperature produces a definite change of dimension in the sheet, anything that prevents this change must itself be subjected to stress and must put a similar stress upon the sheets. Hence, so far as these investigations have been carried, they indicate the value of using the flexible in preference to the rigid bolt as a means of reducing stresses in the firebox.

There is one point that cannot be expressed in cold figures and that is the impression that this work makes on observers. After watching the delicate and sensitive movement of the sheets and staybolts and the difference in the action of the flexible and the rigid bolts, everyone was greatly impressed with the superiority of the flexible bolt as a means of reducing the probable stresses that the several parts of the boiler are called upon to sustain. The progress of this work has driven home in a convincing manner the advantages of flexibility in boiler construction.

Progress and Standardization

Development of Brake Beam and Air Brake Illustrates Need for Free Play of Inventive Genius

During the hearings before the House Committee on Interstate and Foreign Commerce, a number of manufacturers of railway equipment presented voluntary statements as to certain phases of the question of the disposition of the railroads at the expiration of federal operation. During their appearance before the committee these men were practically all asked for their opinions relative to standardization of railway equipment. In response to these questions the following letter was addressed to Representative Esch, chairman of the committee, by Alba B. Johnson, president of the Railway Business Association. The letter, which presents a concrete illustration of the part competition and initiative have played in the rapid development and improvement of railway facilities, is as follows:

Manufacturers of railway equipment upon concluding voluntary statements before your committee were asked by you their opinion regarding standardization. They replied that they favored interchangeability of car or locomotive parts through standardization of dimensions, but regarded it as essential to progress that there be variety of design and ocmpetition among inventors and developers of appliances.

It is due to you and to ourselves that a fuller explanation of our view and of the reasons underlying it should be made. By conference and correspondence we have obtained the knowledge and judgment of members of our association and others. In the subjoined statement we endeavor to demonstrate that competition is essential to progress in service and in economy, that voluntary standardization by the railways acting collectively has long afforded and can continue to afford all desirable interchangeability, and that diversity of design is the indispensable condition for exertions by inventors and by developers of appliances. As bearing upon diversity of design, a description is given of a typical competitive appliance, the brake beam rigging. Authorities quoted in the statement are connected with the several concerns which make such rigging, and speak in response to our request.

As a factor in progress what is at stake is competition. If Congress adopts the principle set forth in Section 9 of the Cummins Bill (S. 2906), which deals with consolidations, the 20 to 35 ultimate systems will be so formed that "competition shall be preserved as fully as possible." The government determines rates, in which competition has therefore largely ceased. What remains is competition in service and economy.

Such competition in the past has been maintained between railways and between makers of devices. The makers' occupational motive for maintaining competition in both directions is self-preservation; but the public has a vital interest in the preservation of these manufacturing enterprises and in the continuance of competing railway systems, since upon such enterprises and such railway competition depends quality and cheapness of transportation performance.

From economical operation, the public benefits through larger railway income, stronger railway credit, more vigorous improvements of and additions to facilities and through a tendency to keep down rates.

Standardization means the elimination of competition.

Insofar as standardization is desirable for the sake of practical stability and convenience of repairs, the railroads themselves, with the co-operation of the manufacturers, have in the natural course of business adopted and employed it. A standard specification in vogue on American railways is not the edict of a potentate or board of potentates. It comes up from below. It must make its way into general approval before it can have the force of a regulation which the minority will observe. So far as the manufacturer goes, the matter of applicability, of usability, which is the same thing as interchangeability is out of his hands without action of government.

For several decades the Master Car Builders' Association and the Railway Master Mechanics' Association (locomotive), scientific institutes of railway officers, have annually added to the appliances whose dimensions and requirements for performance are "specified." These the American Railway Association, as it existed prior to government control, recommended to all the roads. Generally, they were put into effect as soon as announced.

The need of standardization of locomotives is almost wholly imaginary. A locomotive rarely leaves the road owning it or even the division for which it was built; hence in time of peace and almost entirely in time of war all locomotive repairs are made at home.

As to cars, interchangeability has been made universal in the United States. Accompanying this statement we present to your committee copies of two dictionaries issued annually by the Simmons-Boardman Company, publishers of the *Railway Mechanical Engineer*, one dealing with locomotive appliances, the other with car appliances. The latter part of each book contains the standards referred to, with pictures and drawings. From these books your committee can derive a conception of the extent to which the railroads when occasion required have standardized voluntarily.

To grasp the significance of the burden which a developing mechanical practice sustains in transportation progress, it is necessary to bear in the mind the fundamental of railroad economy.

In freight, the problem is the number of tons that can be hauled by one locomotive with one crew—in a word, the train-load. Possibly the largest single factor in the notable prosperity of such a road as the Union Pacific has been the success of the management in attaining heavy train-loading. It was in pursuit of this economy that the late Mr. Harriman gave his days to experiment and devoted hundreds of millions to capital improvements. For augmentation of train-load, railroads in all parts of the country which had been permitted to accumulate the investment basis have poured out expenditures. They have built larger and stronger cars. They have constructed more powerful engines to haul the larger cars and more of these cars to the train. They have provided heavier roadway, rails, and bridges to sustain the enormously more ponderous train and cargo.

These expenditures, by reducing the cost of drawing freight per ton per mile, not only paid for themeselves, but so far offset the rising cost in wages and material as to postpone for years before 1910 the necessity for asking that freight rates be raised. The trainload as a foundation basis of railroading explains the despair of managers when employees proposed extra men in crews and a limit on length of trains.

Passenger trains have been made heavier also. More persons are carried to the car. Steel has taken the place of wood for safety. Speed has been increased for convenience.

To all this development there has been at every stage and in every phase a mechanical limit. For instance, the movement of the train must be controlled. The engineer must be able to slow down or stop in any emergency. That is to say, railways can progress in economy of operation no faster than the development of the brake. The air brake of the 60's replacing for more exacting uses the hand brake, achieved a stupendous advance; but stopping the toy trains of that era was to the stopping of the 100-car train of 125-ton loaded cars of today what the air brake of 1870 was to the air brake of 1919. Progress in the trainload and in the brake has gone hand in hand.

Even in the years when because of patent protection there was only one maker of air brakes, competition was an ever-present influence.

First there was the competition between railways. The most progressive-minded of the managers were perpetually engaged in rivalry for cheaper operation. If practice had been standardized for all lines no departure could have been undertaken on any of them until the whole national system, perhaps a central omnipotent board, could be persuaded. Cars of a certain capacity would have been obligatory until all new cars for all lines contracted for after a specified date might be built larger. Territorial and topographical contrasts in conditions confronting the several lines might imperfectly and tardily be met. The working of this tendency in practice can be observed in the government standard cars allocated to some roads which had long since adopted larger capacity as best suited to their special problems.

Second there was the potential competition of makers who might bring out competing brakes sufficiently original to convince the patent office. A rival actually established itself, though it now in part covers its patent situation by a license arrangement. What kept one concern so long alone in the field was that it diligently developed improvements—in short, it acted as it would have had to act if competition had been actual instead of merely potential. A vivid form of potential competition was that of makers ready to enter the field the moment patent rights expired. To maintain its commercial position the single maker long before each such expiration abandoned the air brake of yesterday and substituted a new device, protected in turn by new patents. The public was benefited because the essential advantage which induced progressive railways to try and use the newer appliance was the net saving in cost of operation through enlargement of the trainload.

A significant feature of the standard vehicles built by the United States Railroad Administration was the effort, in some cases successful, to use an appliance upon which patent rights had run out and thus to exclude from the bidding more recent inventions still protected. From the point of view of the public this is penny wise and pound foolish. It attains a little immediate cheapness. In doing so it exterminates by starvation the breed of inventors whose work is to promote not alone little economies but great ones.

An illustration more typical than the air brake is its adjunct, the brake beam. In what follows it has been thought convenient to employ for concrete illustration one appliance rather than several. For this purpose the device selected is the brake beam. This appliance is attached both to locomotives and to cars. Rigid standardization of its dimensions and of its strength is necessary and is enforced. From six to a dozen types are in use, while unsolved problems with regard to it are today the object of study and experiment. A somewhat full description of this rigging will facilitate an understanding of subsequent references.

The air brake can develop no faster than the beam. For between the air cylinder, whose piston is operated by pressure initiated in the locomotive cab, and the metal shoe which in action is forced against the wheel, there is a mechanism which directly applies the power to the shoe. A failure of that mechanism puts the brake out of commission.

The cylinder piston operates a rod located under the vehicle midway laterally, and by a system of levers moves the two, three or four trussed brake beam structures toward the pairs of wheels which they are to brake.

The performance which is expected of the beam rigging is this: that it receive the cylinder power; that it move so that simultaneously the shoe, which is fastened to it, will be pressed against the wheel; and that it stand the strain.

It is in standing the strain—that is, in the dependability and durability—that progress has been made and is still promised in the brake beam. If a manufacturer claims superiority for his type it is to those qualities that he refers.

The Master Car Builders' standards tell him how many inches the beam must measure from tip to tip and throughout its external outline in order to fit the various cars. They prescribe the height at which the beam must hang above the rail. They require specified dimensions and locations for certain parts of trussed structures. Consequently when a car off the rails of the owning road is found with a damaged brake beam and the road on whose rails it is sojourning is addicted to a beam of another type, the defective beam can be replaced by one carried in stock by the road which does the repairing.

The argument in favor of standardization is that while interchangeability of beams as a whole is maintained with variety of detail, each several part of the beam structure cannot be replaced by a part from another type of beam, but the whole beam must be substituted. Another view prevails. This is that serviceable and safe brake beam repairs are only made when the parts of the beam structure have been put together under the same tests and conditions as surround the manufacture, inspection and acceptance of new beams; whereas such conditions are not and cannot be present on yard repair tracks. The discarded beam is not wasted. It is subsequently carried to a place where under rigid conditions qualified mechanics restore it; and it takes its course of standard inspection like a new beam before it can again be placed on a vehicle.

In their requirements the Master Car Builders' Association includes loads that beams shall successfully carry; but the means by which the maker shall impart the specified power of resistance to the beam and its parts is within his own province. That is the field in which progress lies.

The original brake beam was wooden. As trainloads began to enlarge it was seen that a wooden beam strong enough for the new conditions would be a monstrosity in size. Mr. C. F. Huntoon writes that "the best design of truss metal beam 15 years ago weighing approximately 63 lb., carried a load of 6,500 lb. at 1/16-in. deflection, this deflection being the maximum allowed by the M. C. B. Association, while today a beam of 77 lb. weight, or 20 per cent increase, will carry a load of 15,000 lb. at 1/16-in. deflection, an increase of over 125 per cent in strength and efficiency." Mr. Huntoon attributes such progress "to specialists who have directed their efforts to some one device or detail—each vying with the other to produce an article of superior merit;" and he says, "without this competition and the protection afforded by letters patent, there would be no fast schedule trains and boats, no telephones on the desk or automobiles for convenience or pleasure; in fact, the industrial progress of this country has been stimulated by and is largely due to these very factors."

The advance proceeded through various forms in metal. At first light metal beams met the situation, beginning with a trussed structure of pipe. Further increase in train weights led from year to year to development of more adequate trussed brake beam structures by various manufacturers, differing in the various parts, most notably in the "beam" or "compression" part proper—for example, the "U," the solid bar, the "channel," the angle, the "T" and so on. Each of these types taken in cross section has a distinctive value within itself and within its relation to other parts of the brake beam structure. Each of them represents the means by which inventive genius competes for superiority in meeting conditions as they evolve. Tests of these types and features are continually going on in the railway shops.

There have been strong and eminent advocates of a standard beam. The railway men as a whole have preferred to leave the opportunity open for continued improvement. Since the proposal for a standard beam was made seriously in 1910, substantial improvement has been made.

Mr. A. H. Peycke writes: "The brake beam manufacturers have conferred with the Brake Shoe and Brake Beam Committee" (of the Master Car Builders' Association) "this last year with a view to straightening out a good many points in relation to interchange dimensions, clearance conditions, etc.," and cites a report delivered before the M. C. B. convention in Atlantic City in 1919 by Mr. B. B. Milner, of the New York Central, suggesting changes which are necessary; also giving a complete synopsis of the brake beam situation since about 1905. Mr. Peycke's opinion is that "The standardization of brake beams would be decidedly disadvantageous to the railroads and people of the country, and any attempt to adopt a standard beam would suppress initiative, invention, genius and progress."

Mr. Albert Waycott observes: "Seven or eight different types of brake beams, all interchangeable on equipment in service and all meeting the M. C. B. tests, will surely illustrate how both improvement and competition might easily have been greatly reduced had any one 'type' been insisted upon."

The manifest need today, according to Mr. C. Haines Williams, "is a more strict enforcement of existing M. C. B. rules and more rigid application of test and manufacturing requirements. . . . No single design of beam has advantages sufficient to compensate for the penalty of having brake beams stand still for years. . . . The initiative and unhampered genius that produced the brake beam and brake transmission rigging that has always satisfactorily controlled our high speed trains cannot with safety be destroyed. . . . The success of past practice guarantees proper care of future problems if not interfered with by standardization, which would unquestionably develop indifference on the part of the interested brake beam manufacturers of today. All the present M. C. B. rules, specifications, requirements and safeguards have come, without exception, from the recommendations and practices of brake beam manufacturers."

Whatever may be the future of voluntary standardization, it is our conviction that the best interest of the public lies in leaving the railways free without any government participation in the process.

An important consideration cognate to this view in every line of railway requirements is that of centralized buying. Standardization would, we fear, do more than put a stop to the maintenance of vigorous departments of the manufacturing establishments for the testing and development of new devices and features. Not only would all the companies be reduced, so to speak, to automata filling orders to specifications, but there would be the further tendency to concentration of purchasing in some central bureau. Its responsible heads would probably not get and keep personal knowledge of the reliability and resources of individual makers. Bidding would tend to be controlled more and more by the element of price, and less and less by the element of quality and durability. The bureau would tend to leave in the hands of subordinates the designation of those makers permitted to bid. Inevitably this would degenerate into a stereotyped process bereft of commercial enterprise and intelligence on both sides of the counter.

What demands the future will make, who can prophesy? Mr. Charles J. Graham remarks: "Had the thought of standardization of parts been put into effect some years ago, we would still be using wooden brake beams. . . . The same is true today. There remains ample field for further improvements if they are not stifled by the fixing of standard details for parts."

We are told that locomotives and cars have reached nearly if not quite their maximum capacity; that they already crowd the overhead clearance of bridges and tunnels; that to widen the traffic gage would involve expenditures of appalling magnitude not only in acquirements of wider rights of way but in shifting and relaying existing tracks while traffic was carried on; that to lengthen the vehicles would involve us in costly track problems and complications involving station platforms and the like.

Such pessimism is a counsel of sloth. For freight transportation at least higher actual speeds may be a possibility contained in the now rapid elimination of grade crossings. To what extent will this and other tendencies toward fuller use of cars affect the stresses placed upon every part of the rolling stock? Is it certain that electric propulsion will bring no new conditions in this respect, or that fuel or other source of motive energy in the future is even yet identified? Who can affirm that the controlling factor in future transportation development is yet dreamed of in our physics and chemistry or other branch of scientific pioneering?

The manufacturer has always anticipated each new demand. When it came he was ready for it. He can exist and perform that function only if experimentation is free on the several railway systems and if achievements for the welfare of mankind promise reward to the inventor of appliances and profit to the developer.

Japanese Laborers' Wages.—The average wage for an unskilled Japanese male laborer today is 48 cents and for a female laborer 32 cents a day. A skilled laborer earns from $1.10 to $1.68 a day. These rates are about 70 per cent above pre-war rates. Besides the daily rates, however, yearly bonuses are given of a month's wages, and often considerable more. The working hours may be given generally as 70 hours per week, and the amount of work produced per hour by a Japanese workman is about one-half that produced by an average British workman where large jobs and heavy machinery are concerned.—*The Engineer.* (London.)

RAILROAD ADMINISTRATION NEWS

The number of passengers carried one mile in August was 4,375,694,522, according to the monthly report of the Operating Statistics Section. This was an increae of 8.8 per cent over August, 1918. For the eight months ending with August 31 the number of passengers carried one mile was 28,793,142,453, an increase of 6.3 per cent.

RAILROAD FACILITIES BELOW DEMAND OF TRAFFIC

The railroads of the country are now doing a heavier business for the present season of the year than was ever done in the history of the railroads in normal years, and practically as heavy business as was done at this season in 1918, which exceeded all previous records, according to a statement authorized by the director general on October 12. They have more cars in actual service, after excluding cars held out of service for repairs, than in 1917 or 1918. While the bad-order car situation was greatly embarrassed by the extensive strikes among shopmen in August, the percentage of bad-order cars is now rapidly improving. There was an increase of 52,456 cars in serviceable condition between August 16 and October 4, of which 12,110 were added in the one week ending October 4.

MILES PER CAR PER DAY INCREASING

As indicative of increased efficiency in the use of freight cars, the average mileage per freight car per day in October, 1919, was 27.3, as compared with 26.7 in September, 1919, according to a statement authorized by the director general. The comparison with October of the two preceding years is as follows:

October, 1919	27.3
October, 1918	26.0
October, 1917	25.9

The comparative progress thus made in October is even better than that made in September, as is shown by the following comparison with September of the two preceding years:

September, 1919	26.7
September, 1918	26.5
September, 1917	26.4

NUMBER OF BAD ORDER CARS BEING REDUCED

Steady and gratifying progress continues to be made in connection with the bad-order car situation, according to a statement recently authorized by the director general of railroads.

Excluding cars held out of service as not worth repairing, bad-order cars had fallen on November 15 to 130,833, or 5.2 per cent. The figures since October 4 have been listed as follows:

	No.	Per Cent
October 4	172,210	6.9
October 11	169,343	6.7
October 18	163,986	6.5
October 25	156,372	6.3
November 1	146,702	5.8
November 8	136,238	5.4
November 15	130,833	5.2

Including cars held out of service as not worth repairing, the number of bad-order cars has decreased to 150,133, or 5.9 per cent on November 15. The figures since October 4 follow:

	No.	Per Cent
October 4	191,656	7.6
October 11	188,308	7.4
October 18	183,070	7.2
October 25	175,348	7.0
November 1	166,514	6.5
November 8	155,564	6.1
November 15	150,133	5.9

TRAINMEN SEEK INTERPRETATION OF OVERTIME PROPOSAL

A committee representing the four brotherhoods of train service employees was to confer with Director General Hines on Tuesday, December 2, to ask a more specific interpretation of his recent proposal to allow time and one-half for overtime in freight service, contingent upon the elimination of all arbitraries and special allowances. The committee, which has full power to accept or reject the overtime proposal, was appointed at a conference of the general chairmen of the four brotherhoods at Cleveland, called to consider Mr. Hines' proposal, after the conference had voted to accept his offer of a held-away-from-home terminal rule providing for payment of wages for time held at other than the home terminal after 16 hours. This was as a substitute for rules proposed by the trainmen and firemen providing for pay after 10 hours. About 180 general chairmen of the firemen's brotherhood held a conference to consider what should be done in connection with their demand for a general wage increase, which has not been acted upon by the Railroad Administration.

ORDERS OF THE REGIONAL DIRECTORS

American Red Cross.—The Northwestern regional director, file 33-1-17, urges that every officer and employee be given an opportunity to take a Red Cross membership for the coming year in view of the great humanitarian work the American Red Cross has performed.

Employment of Men in Train and Engine Service.—The Northwestern regional director, file 42-1-87, requires that men entering the service to fill the position of brakemen, flagmen, baggagemen, switchmen and firemen must be able to read and write; will be required to pass uniform examination and will comply with the regulations governing the use of standard watches.

Incomplete Brakes on Gondola Cars.—Supplement 2 to Circular 201 of the Southwestern regional director states that 500 U. S. Standard hopper cars, allocated to the Pere Marquette, built by the Ralston Steel Car Company and numbered 13,000 to 13,499, were placed in service without sheave wheels on brake and hand brake pull rod. The circular instructs that where these cars are found with sheave wheels omitted on the end of the hand brake rod changes should be made at once, regardless of ownership.

Improved Car Handling.—Circular 86 of the Northwestern regional director calls attention to the necessity for the improving of car handling, especially in view of the present acute situation in connection with car supply. In addition to this, particular attention should be paid to the prompt delivery of cars to connections, early arrivals at freight houses and team track deliveries, prompt unloading of equipment and movement of "company" material utilizing the full capacity for loading, which will result in saving of much equipment for revenue loading.

Substitute for Pneumatic Tires.—From Christiania, Norway, Consul General Marion Letcher reports that Lieut. Col. Fridtjof Andersen, a retired Norwegian army officer, has just perfected an invention which he claims will serve a sa substitute for pneumatic tires now used on motor vehicles. The invention involves the use of steel springs tangentially applied to the wheels, with an outer rim of solid rubber, steel, wood or other material. The inventor claims that spring wheels, manufactured according to his designs, may be used on street cars and railway trains, as well as on lighter vehicles. No arrangements have as yet been made for the manufacture of spring wheels.—*Manufacturers News.*

CAR DEPARTMENT

INSULATING TRAIN STEAM PIPES

BY W. N. ALLMAN

THE subject of fuel conservation has been one of considerable discussion during the past few years and at the present time is a matter of paramount importance. The conservation of fuel should therefore not be treated lightly and every phase of the subject should be carefully studied and investigated. There has been much literature published by the various departments of the government, treating the subject in a most complete manner and it is now acknowledged by all to be a vital factor and therefore must not be neglected even to the smallest detail.

In the operation of passenger train equipment there is considerable exposure of the train steam heat line. The radiating surface on an 80-ft. line for a 10-car train would be 500 sq. ft., and there would be a large loss in heat units if this surface was not adequately protected by some efficient form of insulation.

There are a number of types of insulation on the market to-day which may be generally grouped under the laminated type, the moulded type and the cellular type. Primarily, the load is placed on the locomotive and by reducing the amount of steam required to a minimum the saving in dollars and cents is realized.

The problem is to carry the heat to destination—interior of the cars—with the least amount of loss, and this can only be done by properly insulating the train steam pipes. It should also be understood that the efficiency of all insulations varies according to the size of the pipe to which it is applied; according to the temperature of steam in the pipes and the temperature of the surrounding air; another factor is the thickness of the insulation.

The efficiency of pipe covering is the per cent saving which would be obtained by insulating that pipe with a certain material over what would be lost if the pipe were left bare or uninsulated.

This per cent is obtained by subtracting the heat loss of the insulated pipe from that of the bare pipe and dividing the difference by the heat loss from the bare pipe. Expressed as a formula this would then be:

$$E = \frac{A - B}{A}$$

where

E = Efficiency

A = Heat loss through bare pipe.

B = Heat loss through insulated pipe.

The heat losses may therefore be compared directly as follows:

Bare pipes .... 100 per cent
Efficiency .... percent saving
100 per cent—per cent efficiency = loss through insulation expressed as a percentage of bare pipes.

For example, an insulation having an efficiency of 86 per cent allows a loss of only 14 per cent of the loss from bare pipes.

TYPES OF COVERINGS

Not all pipe coverings can be termed good insulation, some being efficient at low pressures, but very inefficient at higher pressures. Some coverings are fairly efficient when first applied but soon deteriorate and do not maintain their efficiency, while others maintain their initial efficiency indefinitely. The underlying principle of efficient insulation is confined to dead air cells, and perhaps one of the best forms of pipe covering is that of the laminated type, which consists of a number of layers of felt composed of asbestos fibre and particles of finely ground spongy material, this combination forming an extremely cellular felt. These layers of felt, being built up in laminated form, confine a large volume of minute dead air cells between the layers, and the general construction makes it a highly efficient covering and one that is most durable as well as maintaining its efficiency indefinitely.

The next best form, perhaps, is the moulded type of insulation, known as magnesia, and which is a light highly efficient insulation. In this type of covering there is also a large number of miscroscopically small dead air cells. These dead air cells cause the air to become stagnant, and thus a very poor conductor, thereby increasing the efficiency. This form of covering, however, is not as adaptable to service on train pipes as is the laminated form, because of the constant vibration which is more or less detrimental to this form of covering. The cellular type would then be considered the next best class of covering for train service and it may be of interest to note the saving that may be realized from the following analysis, which is based on pipe covering one inch thick in each instance, this being the thickness now generally recognized to be the most efficient for train service.

SAVING DUE TO INSULATION

In making this comparison three types of pipe insulation are used, having a known efficiency, and for the sake of convenience they will be designated as *A*, *B* and *C* coverings—all one inch thick.

A = Laminated form.

B = Cellular type, corrugations running around the pipe, not parallel with pipe.

C = Larger form with indentations in layers.

The efficiency of these coverings for a two-inch pipe and for the temperature difference dealt with hereafter, are as follows:

A = 85.84 per cent.

B = 82.00 per cent.

C = 78.60 per cent.

For our investigation we will consider a 10-car train, each car having 80 ft. of two-inch pipe, which is equivalent to 500 sq. ft. of radiating surface. Train line pressure 50 lb., outside temperature 20 deg. F. above zero. The results are calculated as follows:

Temperature of steam in train line at 50 lb. pressure	334.3 deg.
Outside temperature	20.0 deg.
Temperature difference	314.3 deg.

Loss in B.t.u.'s per hour, per sq. ft. bare pipe...	1,070.0
Total radiating surface, sq. ft................	500
Total loss in B.t.u.'s per hour................	535,000
Hours of service per day....................	16
Total loss in B.t.u.'s per day.................	8,560,000

Assuming coal to have a thermal content of 10,000 B.t.u.'s, this would be equivalent to 856 lb. of coal per day loss, or at four dollars per ton $\frac{4.00}{2,000} = .002 \times 856 = \$1,712$ loss per day from bare pipes.

The saving per day effected by using the three types of covering which have been described would be as follows:

Type of covering	Efficiency	Saving per day
A	85.84 per cent	$1.47
B	82.00 per cent	1.40
C	78.60 per cent	1.35

The initial cost of the covering would soon pay for itself and the saving of wasted heat units and ultimate dollars and cents would soon amount to a considerable item. The temperature of steam in train line of 354.3 deg. F. as covered in the above analysis, is obtained from the following formula:

Temperature of steam (saturated) at boiler pressure of 200 lb. per sq. in............	388 deg. F.
Total heat in saturated steam at 200 lb. per sq. in.	1,199.2 B.t.u.
Total heat in saturated steam at 50 lb. per sq. in.	1,178.5 B.t.u.
	20.7 B.t.u.

Since change through reducing valve has been a constant heat change, that is, no work done and no heat gained or lost, the heat in steam at 50 lb. per sq. in. above normal saturation content must be in the form of superheat. Therefore:

$$H_t = S\ (T_s - T_n)$$

Where:

H_t = Total heat above saturation heat content
S = Specific heat of superheated steam
T_s = Highest temperature of superheat
T_n = Normal temperature of steam at pressure given.

Therefore:

$$H_t = 20.7 \qquad S = .57$$

$$20.7 = .57\ (T_s - T_n)$$

$$\text{or } (T_s - T_n) = \frac{20.7}{.57} = 36.3$$

$$T_n = 298.0$$

$$\text{or } T_s = 298.0 + 36.3 = 334.3$$

The above conditions and analysis may be considered normal, and results would vary with temperature conditions. For example, in certain sections of the country during the winter the temperature would be much lower than that considered above, also, as the velocity of train increases the loss is greater and as the foregoing is based entirely on still air conditions, the saving would be even greater and more so by using the best insulation or that having the highest efficiency.

The following table will be convenient for determining the heat loss in B.t.u.'s from bare pipes:

TOTAL HEAT LOSS IN B. T. U.'S PER HOUR PER LINEAL FOOT OF BASE PIPE OF DIFFERENT SIZES AND AT VARIOUS TEMPERATURE DIFFERENCES AS GIVEN BELOW

Pipe Size	Area of Pipe Surface per lin. ft.	50 Deg.	100 Deg.	150 Deg.	200 Deg.	250 Deg.	300 Deg.	350 Deg.	400 Deg.	450 Deg.	500
½-inch	.220	21.5	47.3	79.2	117.3	162.3	215.2	279.1	355.1	451.4	569.8
¾-inch	.274	26.8	59.0	98.6	146.8	202.1	268.5	347.6	442.2	562.2	709.7
1 -inch	.344	33.6	74.0	123.8	183.4	253.7	337.4	436.5	555.2	705.4	891
1¼-inch	.435	42.5	93.6	156.6	231.9	320.8	425.4	551.9	702.1	892.6	1126.7
1½-inch	.498	48.7	107.2	179.3	265.4	367.3	487	631.8	803.8	1021.9	1289.8
2 -inch	.622	60.9	133.9	331.5	331.5	458.7	608.3	789.2	1003.9	1276.3	1611
2½-inch	7.51	73.4	161.6	270.4	400.3	553.9	734.5	952.8	1212.1	1541.1	1945.1
3 -inch	.917	89.6	197.3	330.1	488.8	676.3	896.8	1163.4	1480	1881.7	2375
3½-inch	1.047	102.3	225.3	376.9	558.1	772.2	1024	1328.4	1689.9	2148.4	2711.7
4 -inch	1.178	115.1	253.5	424.2	627.9	868.8	1152.1	1494.6	1901.3	2417.3	3051
4½-inch	1.308	127.9	281.5	470.9	697.2	964.7	1279.2	1659.5	2111.1	2684	3387.7
5 -inch	1.455	142.2	313.1	523.8	775.5	1073	1423	1846	2348.4	2985.7	3768.5
6 -inch	1.733	169.4	371.9	623.9	923.7	1278.1	1694.9	2198.7	2797.1	3556.2	4488.5
8 -inch	2.257	220.6	485.7	812.5	1203	1664.5	2207.3	2863.6	3642.8	4631.4	5845.6
10 -inch	2.817	275.4	606.2	1014.1	1501.5	2077.5	2755	3574.1	4546.6	5780.5	7296
The following losses apply to flat as well as curved cylindrical surfaces:											
B. t. u. Loss per sq. ft. per hour		97.5	215.2	360.0	533.0	737.8	978.0	1269.4	1614.0	2050.6	2590.0
Ditto per degree temp. difference		1.950	2.152	2.400	2.665	2.951	3.260	3.627	4.035	4.557	5.180

NOTE: For other temperatures than those shown in the table, the heat losses can be determined by interpolation.

Locotractors in South Africa.—A contemporary states that owing to the high cost of operating the usual forms of motor truck in South Africa, a modification of the truck tractor is being used. Roads are very poor and during the rainy season are often impassable. The light railway is advocated as the solution and suitable motive power is believed to have been definitely discovered in a gasoline locotractor, a special form of machine intended to take the place of the locomotive on pioneer light railways. The locotraction system uses load-carrying cars running wholly upon rails. The guiding portion of the locotractor also runs on the rails, but the driving wheels, shod with solid rubber tires, run on prepared strips of road metal on each side of the railway track and have greater traction. For a given horsepower and weight the hauling power is stated to be four times as great as with ordinary locomotives having driving wheels running on tracks.

Wood Fuel on Swiss Railways.—*The Times Trade Supplement* states that the results obtained from the use of wood fuel in Switzerland are of considerable interest. The technical difficulties were not so great as was anticipated. On lighting the fires with one cubic meter of wood a steam pressure of from five to six atmospheres was obtained in 1½ hours, for which otherwise 300 kilos of coal would have been required. The cost was approximately $13 (pre-war rate), as against approximately $15 (pre-war rate) with coal. The same maximum driving rates were obtained as with coal. The difficulty of storing fuel for long journeys was met by running a special truck behind the engine.

Refrigerator Cars For The C. P. R.

Steel Underframe Construction, 41 ft. Long, Fitted with Tank Bunkers, Meat Racks and Ventilators

The Canadian Pacific has recently built at its Angus shops, Montreal, an order of steel underframe refrigerator cars, which embody a number of interesting features, both in the underframe and body construction as well as in the refrigerating equipment. The cars are designed for satisfactory service when handling any of the several different commodities which require transportation in insulated cars because of the need of protection from heat or frost, and also for other miscellaneous freight which may properly be loaded in refrigerator cars when they are not required for the transportation of perishables.

As packing house products are regularly handled in Canada by railroad owned refrigerators, these cars are equipped with galvanized iron tank bunkers which permit the use of salt as required to obtain the proper degree of temperature. To prevent the exchange of air through the hatch openings at any time, and especially when the hatches are opened for re-icing, the tanks fit well around the ceiling. Regulation meat racks are included as part of the roof and ceiling construction.

For berry and fruit traffic it is necessary to provide a means of ventilation. This has been taken care of by providing openings in the fronts of the ice tanks near the top, so that when the hatch covers and plugs are opened, air will circulate freely into and through the car. The ventilator openings are fitted with malleable iron frames and close-fitting plate slides, which are secured in a closed position at all times except when the cars are operating under ventilation.

The use of ice or ice and salt when operating under ventilation, is optional, thus providing a wide range of regulation which may be varied to suit the seasons, conditions of the load, and the distance to be moved. Fruit fresh from the field is a very difficult commodity to transport, as the field heat and heat generated by the ripening process produces a condition that is difficult to handle. However, the brine tank ventilator car when equipped with suitable floor racks arranged so that free circulation will take place around the ice and out under the racks, is particularly suited to this traffic. as the use of salt on the initial icing lowers the temperature of the car rapidly, absorbing the field heat and checking the process of ripening. For fruit shipments it is well to apply temporary slats along the sides of the car to provide space for circulation at the sides as well as underneath. All other perishables may easily be transported safely in these cars, provided reasonable care is used in leading so that the air within the car may circulate freely.

Steel Underframe Refrigerator Car with Brine Tanks and Ventilators, for the Canadian Pacific

Whenever the lading requires protection from frost, charcoal heaters are placed in the corner ice tanks, two or more per car, as required.

THE REFRIGERATING EQUIPMENT

Permanent floor racks made of 1¾-in. by 3¾-in. fir are installed in sections, five sections on each side of the car. They are secured with hinges, similar to those used on side doors, to the lining base plank, and when propped up against the car sides, the racks are entirely clear of the floor, thus permitting the floor to be thoroughly and easily cleaned and swept out through the side door openings. The racks are made of relatively heavy material to insure durability, especially when the car is loaded with general freight.

The ice bunkers consist of four rectangular galvanized iron tanks at each end of the car; the tank bottoms are ⅛-in. pressed steel, galvanized after pressing, and the sides are 16-gage galvanized iron. Substantial lugs are riveted near the top. These lugs bear against the underside of the hatch frame and prevent the tanks from jumping when the cars are being switched. The tank supports consist of angle irons which are arranged so that the front supporting angle may be removed without disturbing any tank. After the removal of this angle one or more tanks may be removed and reapplied without disturbing the others.

The drip pan under the tank is sloped from the rear end towards the front of the tank, so as to be as nearly self-clearing as possible. The front edge of the drip pan is made of ⅛-in. pressed steel plate, galvanized. This arrangement avoids, to a considerable degree, the obstruction of free circulation of air down around the tanks and out under the floor racks.

Only the center tanks at the ladder corners are equipped with a drain valve. The remaining three tanks at each end of the car are coupled to this tank by hose connections located two feet above the tank bottom. The drain valve is connected to a pipe extending directly through the car floor.

Insulated bulkheads are provided in front of the ice bunkers. These bulkheads are hinged at one side of the car so that they may easily be swung open for inspection, cleaning or repairing the tanks. These bulkheads have an extension at the bottom with horizontal slats to prevent small crates or boxes from sliding under the bulkhead.

The ice hatches are of U. S. R. A. design, modified only as absolutely necessary to suit conditions.

INSULATION

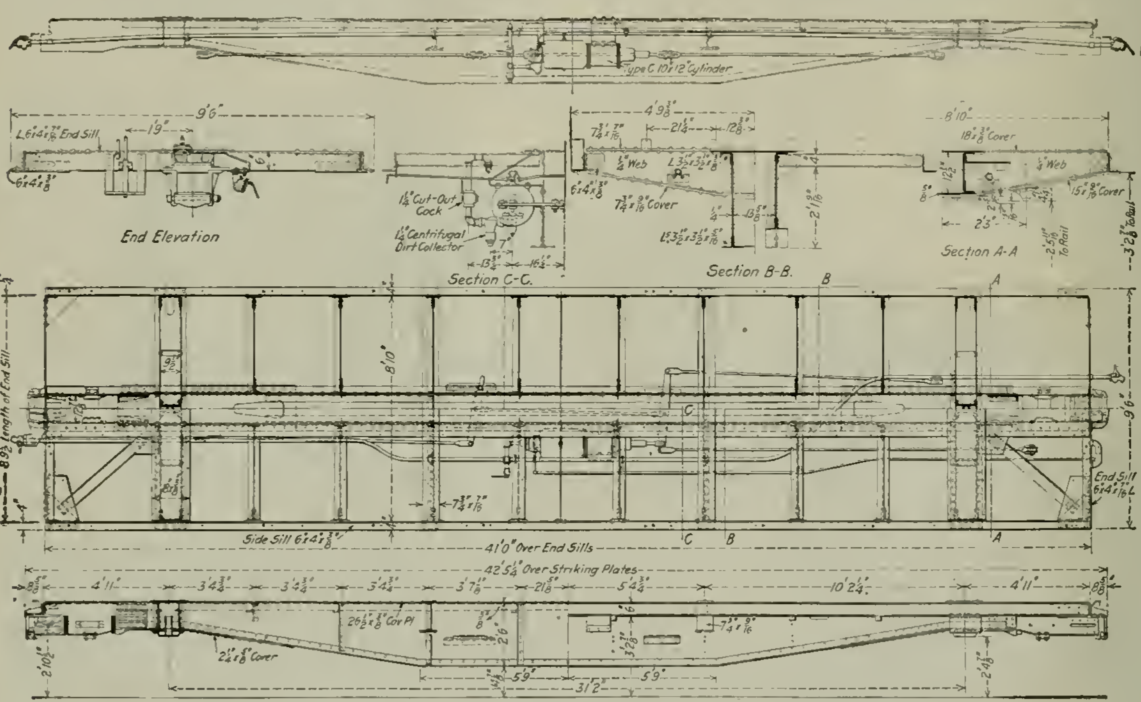
The floor insulation consists of one layer of 90-lb. waterproof insulation paper applied in one piece from side to side and end to end of the car, thereby covering the entire underframe and sub-floor. On top of this are placed the floor stringers. The center stringers rest on and are bolted to the edge of the center sill cover plate, while the intermediate stringers rest on and are bolted to the bolsters, cross-bearers and floor beams. Between the stringers four layers of ½-in. insulation are applied in strips, continuous from end to end of the car. Each layer consists of hair or fibre felt stitched between two courses of 90-lb. waterproof insulation paper. The four layers are applied in two courses of double layers, with nailing strips and ⅜-in. tongued and grooved boards between.

The floor consists of two courses of tongued and grooved boards, the under course ⅝ in. thick, over which is spread a heavy coating of hot, waterproof asphalt, and over this one layer of two-ply asphaltum roofing paper. The top course boards are 1⅛ in thick.

The side and end walls are insulated with three layers of ½-in. insulating material, each layer stitched between two layers of 90-lb. waterproof insulation paper. Side and end walls insulation extends continuously from floor to ceiling and from the door opening to the end of the car, across the end and to the door post opposite the starting point. One layer of the insulation is applied on the outside of the superstructure frame, overlapping and fastened to the sills and plates. Two courses are applied on the inside of the framing, against the ⅜-in. tongued and grooved sheathing. The outside sheathing consists of standard 13/16-in. tongued and grooved car sheathing and the inside lining is 13/16-in. tongued and grooved basswood or spruce. The total thickness through the side walls is 6½ in.

The roof insulation consists of six layers of ½-in. insulating material, each layer stitched between two courses of 90-lb. waterproof insulation paper. The insulation is applied in one piece between the carlines from side plate to side plate. It is applied in three double layers, each double layer supported on ⅜-in. tongued and grooved boards.

On the top side of the ceiling boards one layer of 90-lb. waterproof insulation paper is applied in one piece from side to side and end to end of the car.



Steel Underframe for the Canadian Pacific 41-ft. Refrigerator Cars

SUPERSTRUCTURE FRAME

The principal framing members of the car body are fir, excepting end sills, end posts and end braces, which are of oak or maple. All of the posts and braces are set in cast iron pockets with the exception of the end post and braces, which are set in special cast steel pockets, each having a high flange on the outside to prevent the lower ends of the posts and braces from springing over the top of the casting. Each casting is bolted directly through the steel end sill flange with two ⅝-in. bolts. This is to prevent the pocket from tipping out and also to avoid trouble caused by dowels splitting the wood end sill.

Diagonal brace rods are employed at each side frame panel to reduce racking to a minimum.

The spacing of the carlines coincides with the spacing of the meat rack cross supports, and the supporting bolts pass through the car-lines, thus avoiding longitudinal blocking, which is undesirable, particularly on account of interference with insulation. At alternate carlines ¾-in. cross tie rods are applied.

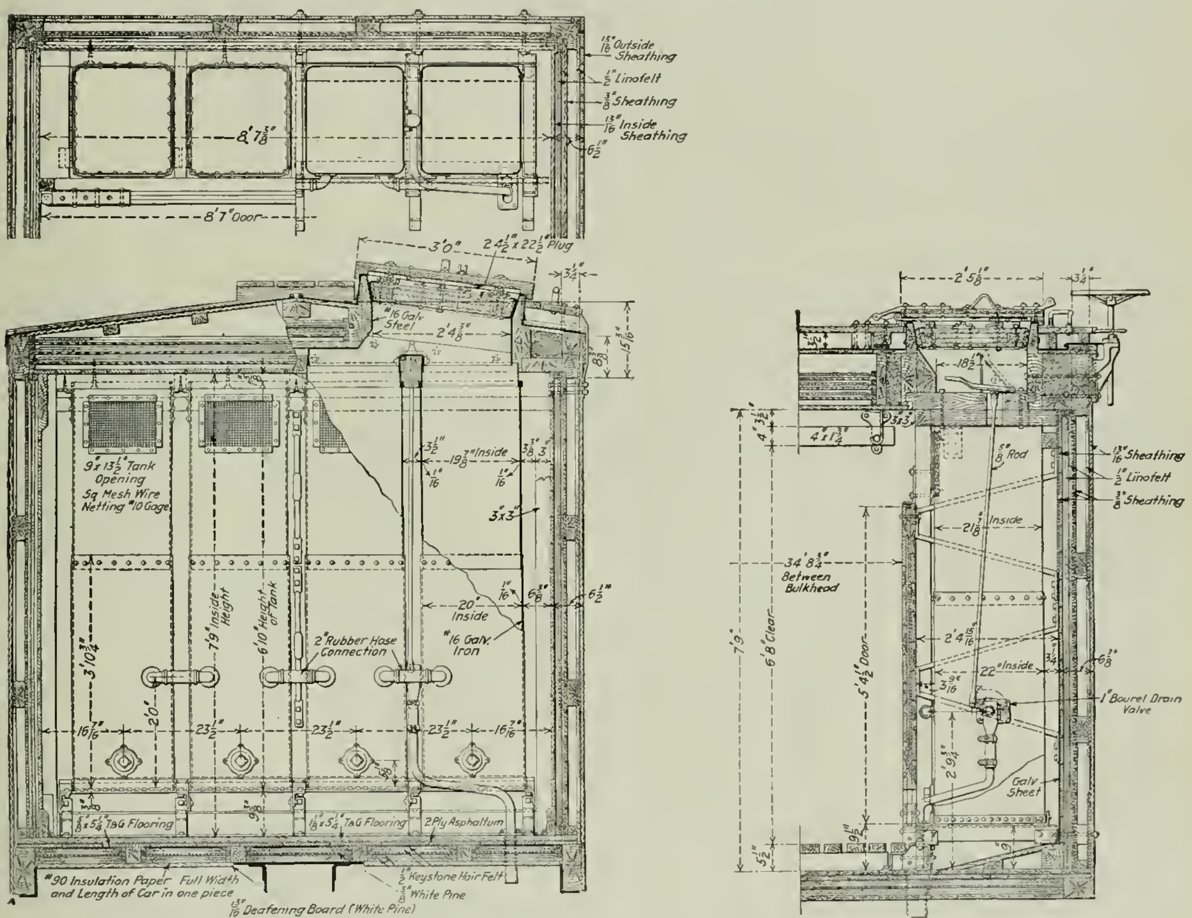
The framing and insulation of this car are so arranged that the roof frame may be assembled on the shop floor and then placed on edge, while the ceiling boards are applied. This enables the builders to work at all times to the best advantage, which results in good work rapidly done.

The roof is galvanized iron, type XLA, flexible, applied over a single course of boards and one layer of two-ply asphaltum roof paper. As already noted, the spacing of the carlines is governed by the spacing of the meat rack supports and on account of the roof insulation the roof mullions and running board saddles are spaced to coincide with the carline centers; this provides a solid construction for nailing the mullions.

The roof sheet pivot saddles are secured by carriage bolts applied through a special washer nailed on the underside of the ridge pole; this washer when applied is L-shaped and is secured by two nails. After the carriage bolt has been applied the projecting end of the washer is bent back under the bolt head to prevent the bolt from dropping down. The hole in the washer is square, to suit the shank in the bolt head.

The side doors are equipped with W. H. Miner fasteners. The threshold plates are of pressed steel with a shallow shoulder at the inside edge for the stripping on the lower inside edge of the door to close against. The open door fastener consists of a link and bolt arrangement that cannot become unfastened accidentally.

Side door thresholds and all metal work on the interior of the cars are heavily galvanized by the most reliable known process.



Arrangement of the Brine Tanks and Body Construction Details of the C. P. R. Refrigerator Cars

THE UNDERFRAME

The underframe is of the center carrying type. The center sills are 30 in. deep at the center portion, composed of web plates ¼-in. thick, a ⅜-in. by 26½-in. top cover plate continuous one piece from end to end of the car, top flange angles of 3½-in. by 3½-in. by ⅜-in. section, and 3½-in. by 3½-in. by 5/16-in. bottom flange angles. The center sill bottom cover is of ⅝-in. by 21¼-in. plate.

The bolsters are of the box girder type, composed of ¼-in. pressed steel diaphragms, with a ⅜-in. top cover plate, 18 in. wide, and a 9/16-in. bottom cover plate, 15 in. wide. The crossbearers are of single web girder construction, consisting of ¼-in. pressed steel diaphragms, with a 7/16-in. by 7¾-in. top cover and a 9/16-in. by 7¾-in. bottom cover. The floor beams are 4-in., 8.2-lb. Z-bars, and the side sills are 6-in. by 4-in. by ⅜-in. angles. The end sill angles are of 6-in. by 4-in. by 7/16-in. section.

The draft arms are of ⅜-in. pressed steel. The rear draft lugs are secured to the draft arm and center sill splice, and are also riveted to the center sill bottom cover. The front draft lugs are designed to receive a cast steel coupler striking plate and cast steel carry iron; the latter is secured by a 1⅜-in. bolt passing through the lower front corners of the draft lugs. The cast steel striking plate has an extension arm for the angle cock bracket, so arranged that the bracket may be located correctly for 9¼-in. or 12-in. coupler heads.

The cars are equipped with friction draft gear, cast steel yokes and 5-in. by 1⅛-in. coupler yoke keys.

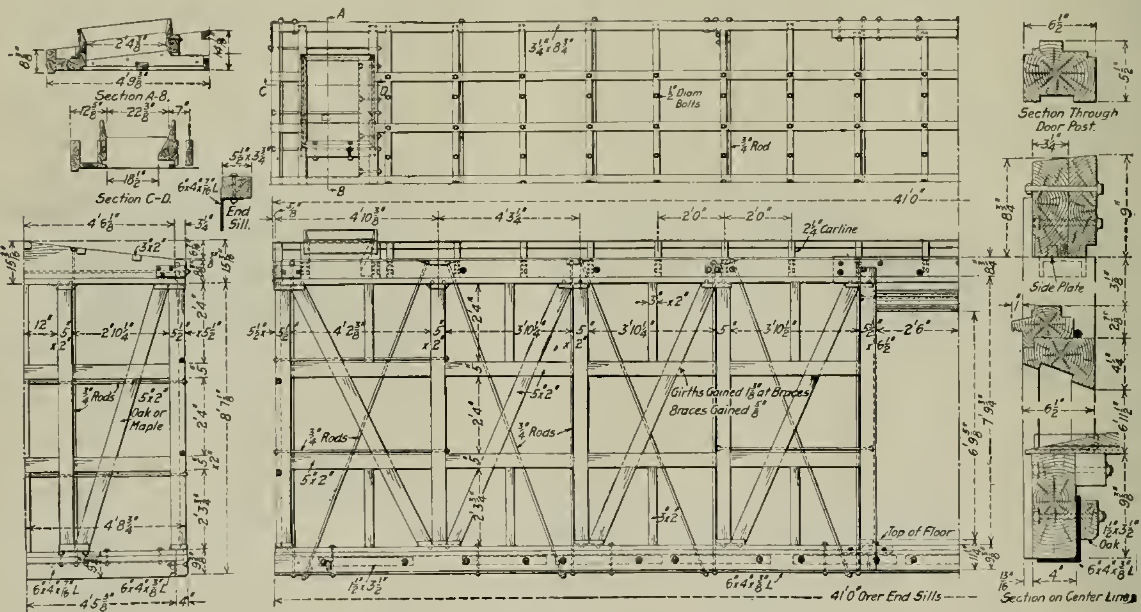
TRUCKS

The cars are equipped with C. P. R. standard 40-ton arch bar type trucks, having Simplex bolsters designed to support the center pin in the truck bolster. The truck columns are of the Harrigan pinless brake hanger bracket type. Side bearings are of the roller type located 27-in. from the car center.

Adjustment of brake piston travel is provided for on the floating lever fulcrum, making it unnecessary to change the adjustment on the trucks after they have been correctly adjusted when the car is built, except that variations in the dimensions of brake beams and rods applied in renewals may require the truck levers to be readjusted.

The brake mast is 1¼-in. square and is fitted with a snow and ice proof ratchet and dog.

The tare weights of these cars average between 59,000 and 60,000 lb., resulting in a limit load capacity, including ice, of 72,000 to 73,000 lb.



Superstructure Frame of the Canadian Pacific Refrigerator Cars

SOME CAUSES OF HOT BOXES*

BY S. W. CRAWFORD
President, More Jones Brass Company, St. Louis, Mo.

The M. C. B. type of journal bearing used in railroad cars has been standard for a great many years, although there have been many efforts to develop other types to substitute it. The first bearings were made of solid bronze, and the first linings used in bearings were made by sweating in a sheet of lead, which was done to overcome the variation in size of journals due to wear. The solid bronze bearing, when applied, would not fit the journal and consequently, it would frequently cause trouble until it was worn down to a journal fit. The thin sheet lead lining was a decided improvement on the solid bronze, as it would give under the load and fit the journal, but as it was very thin, it only provided a starter for the bearing, following which the lining was increased in thickness, by making the lining of babbitt metal, until we finally developed the filled type of bearing, which was a bronze shell, filled with babbitt.

As the lining thickness was increased the babbitt was made comparatively harder, so it would withstand the load. This provided a cheaper bearing, but they have been universally discarded for the reason they were not capable of withstanding the same load or strain as the solid bearing and as a result, caused a great many hot boxes.

A classification of bearings was provided by the M. C. B. Association for filled journal bearing linings ⅜ in. or over in thickness; solid bearings having lining less than ⅜ in. thickness.

A reaction took place. As the use of hard babbitt had been developed, and the thickness of the lining gradually reduced without reducing the hardness of lining, many hot boxes were the result. Bearings would not fit themselves to the journals with the bearing area so small. If the load is too great for the surface area of bearing, the filament of lubrication will break, and a hot bearing will be the result.

I had a case on a road, where they had been using filled

*From a paper read before the St. Louis Car Foremen's Association.

journals bearings for years, and decided, due to the fact that they had very carefully figured over the cost on solid bearings, as compared to filled bearings, to adopt the use of solid bearings, with ¼ in. thickness of lining. The road had specifications, and the lining metal they had been using was what we call an 18 per cent lining, a good one in a filled bearing. But as the thickness of lining had been reduced, the lining metal proved to be too hard and resulted in a great many hot boxes. I was called on to investigate these conditions, and found in some cases as many as a dozen bearings to have been applied to one pair of wheels, all of which were removed before they had fitted themselves to the journal. A conference was called of the car men, and as the universal opinion was that the lining was too hard, we suggested a change, reducing to 10 per cent. As this was quite a big reduction in the degree of hardness, it raised the question as to whether we would shorten the life of the bearing from a wearing standpoint. Quite the opposite proved to be the case, as the bearings lasted longer, and as a result, we today exercise as a standard, the 10 per cent lining, unless the specification of the railroad is otherwise.

I believe our hot box troubles are less than at any time I have ever known, but there is no doubt room for further improvement. We can build up better efficiency in bearings as we do in everything else, by close co-operation. We are doing in the brass business now what we did not think of years ago, and that is to get out on the road with the men using these bearings, studying their side of the situation, and studying conditions under which they are operating.

If we are going to get best results, we must establish the best practice, not at one point, but at all points. Men must be made familiar with the material they are using—not only the bearings, to see that they properly fit the wedge and journal, but they must know that the waste, etc., which they are using is of a quality to furnish the lubrication for that bearing. I have found cases, which showed, upon examination, that the oil from the waste in the oil box would only feed out of the packing one-half to one inch in depth. The remainder of the packing in the box had a great quantity of oil, sufficient to lubricate for a long time, but it could not get to the journal. That was due to the fact that the waste was not of a quality to feed the lubrication. You can have a lamp full of oil, but produce a poor light, because the wick is not of a quality that will feed the proper amount of oil to produce the light. The same applies in the oil box with the waste, which is the wick.

Generally, wherever you find cracked linings in journal bearings, you will find very careful inspection. The cracked lining is caused where the bearing is not getting enough lubrication. The temperature reaches a point where it fuses the solder which holds the lining in the bearing at about 400 deg. F. The fusing temperature of the lining is about 500 deg. As there is 100 deg. difference between the fusing point of the solder, which holds the lining in the bearing, when the temperature reaches the fusing point of the solder, it will loosen the lining. Then, if the bearing is given attention, and you re-establish the proper lubrication, the bearing will cool down, and when it is cooled down, that portion unsoldered remains loose. The result is, the vibration of the loose lining running over frogs and crossings, causes it to crack. That is why I say, wherever you find cracked linings, the road is giving close inspection to the cars. If it did not, instead of having cracked linings, the babbitt would have been melted out.

A great many hot boxes are brought about through some carelessness in applying bearings, such as allowing waste or dirt to get between the journal and the bearing. If it does, it will almost always produce a hot box, because it will stop the flow of lubricant, and cause the bearings to pinch. The waste between the bearing and journal will burn and carbonize, in which case it will make a very hard spot, and cut the journal. We have a great many times received complaints regarding hard spots in the lining. The hard spots are usually caused by the filament of lubrication being broken, and allowing the lining metal to come in contact with the axle, which will burnish it, and make a bright spot in the bearing. That spot is no harder under the polished surface than the other metal, because we cannot produce a lining metal harder in one part of a bearing than in the other. If a spot is burnished in a journal bearing, it takes on a very bright, smooth surface, like glass, and the oil will not lubricate under the polished surface. If the spot is removed by scraping, the bearing can safely be reapplied.

I have found a lot of cases where journal bearing wedges did not have the proper clearance on the bevels of the brass, and in some cases the wedges extended down so that they formed a bearing on the lower edge or lugs of the brass. This would cause the brass to pinch on the journal, resulting in hot boxes. Under no circumstances should wedges be a tight fit on journal bearings.

If we get together and work for a standard practice, we can get results that would probably mean eliminating the necessity of sending men along with a pair of wheels when applying new bearings, which is the practice on some railroads, and not on others. I can see no good reason why it should be necessary to send men along with a pair of wheels, to see that bearings will run, if the care is exercised to see that the bearings fit properly in wedges, box and journal, and the proper packing and lubrication is applied.

METHOD OF DETERMINING THE MOISTURE CONTENT OF WOOD

The moisture content of lumber gives a good indication of the amount of shrinkage which may be expected to take place during seasoning. For that reason many railroads specify the maximum percentage of moisture permissible in lumber for freight cars, particularly in single sheathed cars. The following directions for determining the moisture content of wood, issued by the Forest Products Laboratory of the United States Forest Service, are therefore of interest.

FIVE STEPS IN MAKING A MOISTURE DETERMINATION

(1) Select a representative sample of the material. (2) Immediately after sawing, remove all loose splinters and weigh the sample. (3) Put the sample in an oven maintained at a temperature of 212 deg. F. (100 deg. C.) and dry until constant weight is attained. (4) Reweigh the sample to obtain the oven-dry weight. (5) Divide the loss in weight by the oven-dry weight and multiply the result by 100 to get the percentage of moisture in the original sample. Thus,

$$\text{Percentage moisture} = \frac{(W-D)}{D} 100$$

where

W = Original weight as found under 2 above
D = Oven-dry weight as found under 4 above.

Selection of the Sample.—If possible, the sample should be taken from near the center of the piece. Wood gives off or takes on moisture more rapidly from the end grain than from the side grain and as a result there may be considerable difference between the moisture content of the ends and center of a stick. For this reason a sample from within about a foot of the end of a long board may not be representative. Short pieces of wood dry out much more rapidly than longer ones. In order to reduce the time required for drying, therefore, the length of the sample in the direction of the grain should usually be about one inch. With material one square inch or less in cross-sectional area, however, a sample over one inch long is generally desirable and the length in this case may be chosen so as to give the sample a volume of two or more cubic inches. The other dimensions may be equal to the cross section of the board from which the sample is taken.

Weighing.—It is important that the weight be taken immediately after the sample is cut, for the material is subject to moisture changes on exposure to the air. The degree and rapidity of change are dependent on the moisture content of the piece and the air conditions to which it is exposed. In order to insure good results the weights should be correct to within at least one-half of one per cent.

Drying.—When placed in the oven for drying, the samples should be open piled to allow free access of air to each piece. The oven should have some ventilation, thus allowing the evaporated moisture to escape. A thermometer should be provided by which the temperature can be ascertained at any time. The temperature should at no time exceed the boiling point of water (212 deg. F.) or distillation of the wood may take place, and erroneous results be secured. From 24 to 96 hrs. of oven drying may be required for the sample to reach a constant weight, depending on the size and kind of wood and the amount of moisture it contains.

Reweighing.—As in the case of the first weight taken, it is essential that the sample be weighed soon after being removed from the oven.

A typical example of the computation necessary for determining the percentage of moisture is given below: A 2-in. by 2-in. by 1-in. sample of air-dry Sitka spruce weighed 30.8 grams. The sample after oven-drying weighed 27.5 grams. Find the moisture content of the sample.

$$\text{Percentage moisture} = \frac{(30.8 - 27.5)}{27.5} 100 = \frac{330}{27.5} = 12.$$

HANDLING EQUIPMENT WITH DEFECTIVE SAFETY APPLIANCES

BY M. J. LACOURT
District General Car Foreman, Chicago, Milwaukee & St. Paul

Railroad officers often place wrong interpretations on the handling of equipment having penalty safety appliance defects. Reportable safety appliance defects should not be confused with penalty defects. A car having a reportable defect may be moved in trains; a car having a penalty defect cannot be moved except for the purpose of repairs when repairs cannot be made where the car is found defective, and the movement must be to the nearest point where repairs can be made. The car must not be otherwise used between stations or yards.

Any movement of a car having a penalty defect was held to be a violation of the law as originally passed. However, it was practically impossible to enforce this act and Congress in adopting the amendment of 1910 undoubtedly had this in mind. The following is a verbatim extract of the section of the Safety Appliance Act bearing on this subject:

Section 4.—That any common carrier subject to this Act using, hauling or permitting to be used or hauled on its line any car subject to the requirements of this Act not equipped as provided in this Act shall be liable to a penalty of one hundred dollars for each and every such violation, to be recovered as provided in Section six of the Act of March second, eighteen hundred and ninety-three; as amended April first, eighteen hundred ninety-six; Provided: That where any car shall have been properly equipped, as provided in this Act and the other Acts mentioned herein, and such equipment shall have become defective or insecure while such car was being used by such carrier upon its line of railroad, such car may be hauled from the place where such equipment was first discovered to be defective or insecure to the nearest available point where such car can be repaired, without liability for the penalties imposed by Section four of this Act or Section six of the Act of March second, eighteen hundred and ninety-three, as amended by the Act of April first, eighteen hundred and ninety-six, if such movement is necessary to make such repairs and such hauling of such car shall be at the sole risk of the carrier, and nothing in this section shall be construed to relieve such carrier from liability in any remedial action for the death or injury of any railroad employee, caused to such employee by reason of or in connection with the movement or hauling of such car with equipment which is defective or insecure, or which is not maintained in accordance with the requirements of this Act and the other Acts herein referred to; and nothing in this proviso shall be construed to permit the hauling of defective cars by means of chains instead of drawbars, in revenue trains or in association with other cars that are commercially used, unless such defective cars contain live stock or "perishable freight."

In applying the act care and good judgment must be used in interpreting it as to the nature or extent of the damage which a car must carry in order to permit of moving it to a shop. The place where the car is located should be considered as well as the nature of the defect. By moving the necessary facilities and material to the car any defect could be repaired. If necessary, a car could be built at any outlying point, but that is not the intent of the law. The law should be interpreted to mean that a car found defective at a point where the road does not maintain the necessary facilities and men, undoubtedly could be moved for the purpose of repairs to the nearest available point where that class of repairs is ordinarily made. In choosing between two points where the class of work intended might be handled, one point may be a little nearer, but the other point more readily available, due to the fact that the car could be moved to this point by one train movement, whereas the nearest point may require the switching of the car at some terminal point. In such cases the most available point would be the proper point to which to haul the car for repairs.

The law requires that a car which becomes defective while being used by the railroad should be repaired where the car is first discovered, thus avoiding injury to switchmen and others who are required to move the car in case it is to be moved for the purpose of repairs. The law is for the protection of all employees. The lives of carmen should not be endangered by requiring them to take unnecessary chances in a yard where switching is going on constantly to make repairs which might require considerable work between or underneath cars. In endeavoring to make repairs to a car on a yard track there is danger of tying up the terminals or seriously interfering with the operation of trains, all of which should be taken into consideration.

The Safety Appliance Act applies to equipment used on side tracks and yard tracks, as well as on main lines. A car having a penalty defect must under no circumstances be offered in interchange, nor must a car in this condition be received in interchange, as under the amendments above mentioned only the railroad on which the car becomes defective has a right to move a car for repairs on its own line.

The hauling of cars by means of chains in revenue trains or in connection with cars commercially used, except cars containing live stock or perishable freight is prohibited, unless such cars, when hauled, are not in revenue trains or in association with cars commercially used. It would be permissible to send a locomotive to haul in chained up cars to the nearest available point where the cars can be repaired. It would be a violation of the law to haul such cars even in a non-revenue train out of or through a point where the requisite repairs can be made; further the hauling of the car must be for the purpose of repairs and not for the purpose of disposing of the contents.

It might be well to sum up the Safety Appliance defects involving various parts of the car.

	Combinations of defects		Combinations of defects
Air brakes	34	Ladders	9
Hand brakes	101	Height of couplers	3
Hand holds	7	Sill steps	8
Uncoupling attachments	28	Safety railing	3
Coupler and parts	20	Hand railing	4
Running boards	16		

It may be noted by the above list of safety appliances that each becomes defective in numerous ways, many cases constituting reportable defects only, but all of sufficient importance to require close attention to avoid injury to employees and the traveling public.

Car Wheels and Their Defects*

A History of the Chilled Iron Wheel With a Discussion of Methods for Securing Maximum Service

BY W. F. TIDSWELL
Michigan Central, Detroit, Mich.

The first wheels designed to run on rails were made of wood, with the flange built up about an inch. These were introduced in 1649 and were used in all classes of service. They continued in general use until about 1753, at which time the cast iron wheel came into use. It took about fifteen years to convince people that the iron wheel had come to stay and in 1767 the cast iron wheel came into general use. The wheel hub was split and clamped on the axle with bolts through the hub and was also keyed to the axle.

In the years from 1767 to 1843 many different forms of wheels were brought out, the principal one of which was the double plate wheel. The general tread outline was the same as that in use at the present time. The tread was narrower, being 3¾ in. wide, the flange about 1¼ in. high and the standard wheel was 24 in. in diameter. The inside and outside plates extended from tread to tread, in a convex form.

Vertical Flange

Slid Flat Spots Causing Comby Tread

with a hollow space between the plates. The hub between the plates was separated about ½ in. The wheel was either shrunk on the axle or pressed on.

In 1849 a patent was granted to I. Van Kurran for a new design of wheel, and it became popular for a while. This was quite a departure from the wheel of 1843. It was a double plate wheel, but the plates met about half-way between the tread and hub, with a cored space between the tread and the center of the plate, and another cored space between the hub and the center, making two separate cores between the hub and tread. The tread was about 4 in. wide, 28 in. in diameter, and had a chilled tread. Chilled iron tires were used on locomotive drivers until 1865.

On October 8, 1850, N. Washburn was granted a patent for a double plate wheel, the two plates merging into one, and reinforced on the back by brackets or ribs. This style of wheel has been in general use since that time.

Previous to 1843, wheels were made of soft iron, the method of chilling the tread not being in use. The discovery of this, like many other important improvements was said to be accidental. About 1804, or 1805, a foundry man in England accidentally spilled some molten iron on a cold iron plate, and on examination, found it to be very much harder than iron poured into a sand mould, and from this simple beginning, the chilled iron car wheel was evolved.

The Washburn wheel weighed about 500 lb. The tread widths had been a subject which each railroad settled to suit its own particular ideas, there being no interchange of cars on different roads. Each car was run to the exchange point and the freight transferred to other roads. Another thing which prevented exchange of cars was the track widths. Each railroad established its own track gauge without any consideration for the other.

After the Master Car Builders Association was organized in 1866, many of the differences between different railroads were ironed out, and some agreement arrived upon, looking toward a standard system not only of car wheels, but many other car parts.

At that time cast iron wheels were in use under both freight and passenger cars. The design of the wheel and the method of manufacture had been left to the wheel makers, and it was not until 1893 a standard wheel was adopted.

In the early 70's, steel wheels came into use under passenger equipment, and in 1872 Mr. Adams, of the Boston & Albany, stated in the M. C. B. Convention, that the B. & A. was equipped with steel wheels under their entire passenger equipment. In 1868, a resolution was offered in the M. C. B. Convention, to make the standard track gage 4 ft. 8½ in., and the wheel tread 5 in. wide.

The standard axle also adopted at this time had journals 3¾ in. by 5½ in. It was not long after this, that a car of greater capacity was designed, with an axle with journal 3½ in. by 6 in. This was known as an E. L. L. (extra long and large). It is a wide step from this size to the 6 in. by 11 in. journal of the present.

WHEEL FAILURES

Briefly, the wheel failures or defects which justify renewal are as follows: Sharp flange or worn flange, shelled out, burnt chill, either from sliding or from brake application, worn tread, worn through the chill, chipped flange, chipped rim, etc. The most common cause for removal is worn flanges, next worn tread, tread worn hollow, then brake burn, brake slid, shelled out, worn through tread and cracked flanges. If there are no inherent defects which would cause their early removal, and if they are not subjected to abuses, such as wheels sliding, truck out of true, air brake not properly repaired, etc., etc., will last out their alloted time and mileage barring accidents.

WORN OR SHARP FLANGES

The first defect of car wheels to be considered is worn flanges. There are several reasons for worn flanges. One

*From a paper presented before the Car Foremen's Association of Chicago.

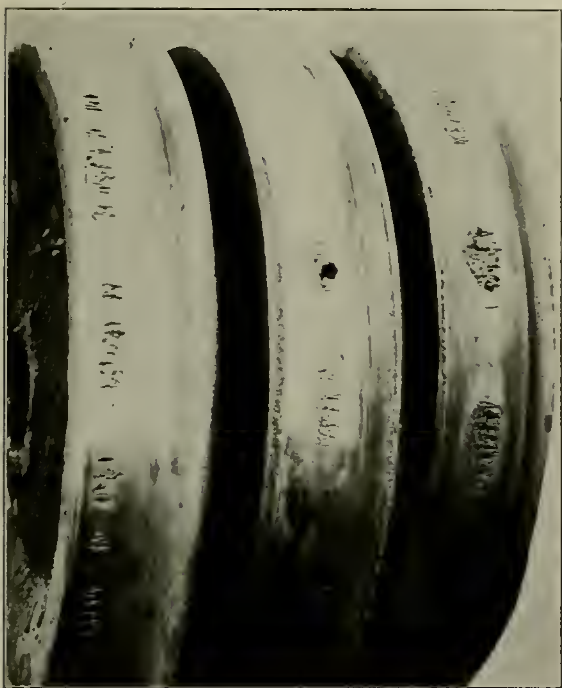
is the mismating of wheels when first mounted. When cast wheels are first made at the foundry, one of the first things done after the wheel is cleaned is to measure the circumference and mark the wheel accordingly. This is called "tapping" and the sizes marked on the plate of the wheel are called tape sizes. Wheels whose tape sizes do not correspond should not be mounted on the same axle.

Another reason for flange wear is that the truck may be out of square. When this is a fact, the wheels do not track properly. One wheel is ahead of its mate, consequently the flange hugs the rail, making an undue amount of wear on the flange of one wheel.

Another cause for sharp flanges that car repairers can do much to rectify is improper clearance of side bearings. If the car rests heavily on the side bearings, the truck is not able to adjust itself readily to the tracks. Too much space between the car body and side bearings will cause the car to sway. This swaying is very bad on the trucks, axles, wheels and rails.

WORN TREAD

Worn tread is first cousin to sharp flange. Worn treads may occur from the same causes as sharp flanges. If a pair of wheels, one of which has a sharp flange, is examined, it



Chilled Iron Wheels with Treads Destroyed by Brake Burns

is very liable that the companion wheel will be found with a worn tread, because the wheel having been run in one position grinds out the tread either on account of one wheel being larger than the other or the truck out of square.

There is one other cause which will produce these defects, and that is the wheels not being mounted equidistant from the ends of the axle. This not only causes the wheels to crowd against the rail, but it also brings an extra amount of wear on the journal collars.

BRAKE BURN OR BURNT CHILL

A wheel that is brake burnt is easily distinguished by cracks across the tread of the wheel. Sometimes these cracks are only hairlines, and in other cases there is a separation of the metal, a sixteenth of an inch or more in width, and covering the entire periphery of the wheel. This is caused by the brake application continuing for a long period, heating the tread of the wheel, and causing the iron to separate on account of the expansion of the metal.

Brake burns occur in some classes of equipment more frequently than in others, for instance, fast refrigerator line cars. These cars are designed for 60,000 lb. capacity, and are equipped with 4¼ in. by 8 in. axles and 625 lb. wheels. This class of car is not in the same kind of service as a 30 ton merchandise car, but on fast freight service. The speed at which these trains move is much faster than the ordinary freight train, consequently when it is necessary to stop the train there is a longer application of the brake. This naturally generates heat on the tread of the wheel, and as a result brake burns and broken plates occur more frequently in this service.

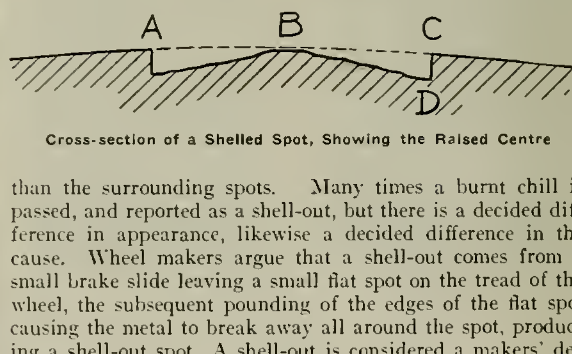
The design of the wheel does not provide sufficient metal to take up the heat. This causes the tread to expand, and as the tread expands the hairlines or separation of the metal occurs on the tread, or a crack in the plate of the wheel, resulting in either brake burns, cracked plates, cracked flanges or brake slides.

CHIPPED RIM

This occurs from the wheel tread being worn hollow, the high part of the rim striking on the switch frogs or switch points, breaking off the rim of the wheels. The heating of the treads is also responsible for cracks occurring in flanges, particularly so if the brake shoe crowds against the flange of the wheel. The flange not being large enough to carry away the heat, the expansion causes the flange to crack at the throat or fillet of the flange.

SHELLED OUT

A shelled-out wheel is one where the metal of the tread has shelled away from the center, leaving the center higher



Cross-section of a Shelled Spot, Showing the Raised Centre

than the surrounding spots. Many times a burnt chill is passed, and reported as a shell-out, but there is a decided difference in appearance, likewise a decided difference in the cause. Wheel makers argue that a shell-out comes from a small brake slide leaving a small flat spot on the tread of the wheel, the subsequent pounding of the edges of the flat spot causing the metal to break away all around the spot, producing a shell-out spot. A shell-out is considered a makers' defect, and subject to replacement by them.

I have been told by some wheel makers that brake slides have been found on engine truck wheels. I have never seen this, but I have seen a typical shell-out on wheels in this service.

Greater care should be taken in reporting the defects for which wheels are removed. If the inspector calls a brake burn a shell-out, and the next man who sees the defect reports it something else, there is bound to be confusion. It is this report that guides the man in the office in making up his records and charges.

CRACKED PLATES

Another frequent cause for wheel removals is cracked plates. Cracked plates are caused by the expansion of the tread through heat generated by the brake shoe. The heating of the tread produces a strain on the wheel, at the juncture of the front and back plates.

BRAKE SLIDE

A brake slid wheel can do more damage to equipment and rails than any other wheel defect. The continual pounding of the flat spots on the rails will loosen every bolt in the truck, and broken rails are very often traced back to brake slid wheels. Spots where the wheel has worn through the chill have a close resemblance to brake slides, but are easily distinguished. The brake slide will have a flat spot with more or less sharp edges, whereas, a spot worn through the chill will have the edges worn over or rounded, leaving no well defined flat spot. A wheel worn through the chill is clearly a maker's defect, and one that cannot be told by inspection of the wheel when new. The wheel when made may have a much thinner chill on one side of the wheel than on the other, and there is no way of telling this except by breaking the wheel.

Shelled Out Spots on Wheel Tread

A very common cause for brake slides, and the causes are numerous, is defective brake rigging, due largely to lack of inspection to the air brakes. Another is the angle at which the brake shoe is hung from the truck. If the angle of the brake hanger in relation to the wheel is too great, the shoe on one pair of wheels in the truck will lock against the tread of the wheel producing tremendous leverage, while the other pair in the same truck will have but little leverage depending on the direction the wheel is revolving. This can be remedied in nearly all cases by bringing the point of suspension of the hanger closer to the wheel.

The number of accidents, the safety of the traveling public, and the successful transportation of freight depends largely on the careful inspection of each wheel under every car, so that defective wheels may be discovered and removed before there is a possibility of accident. The inspector should take no chances on a defective wheel, nor at the same time cause the removal of a wheel which is in the safe limits of good practice.

DISCUSSION

F. K. Vial (Association of Manufacturers of Chilled Car Wheels, emphasized the importance of the correct mating of car wheels when mounted on axles, and illustrated his remarks by figures showing that one wheel would slide a considerable distance even though tape figures are within 1/8 in. of each other. He also spoke of the difficulty of deciding the cause of shell-outs.

In answer to a question Mr. Tidswell stated that in many cases the breaking of flanges in the throat or fillet of the flange is caused by the brake shoe crowding against the flange of the wheel, which, when the brake is applied heats the flange of the wheel, which is not big enough to carry off the heat. He recommended that the brake beam and brake shoes be hung as nearly central with the axle as possible, which, if the beams are properly made, will bring the brake shoe square against the tread of the wheel.

It was brought out that a large part of the damage done to wheels was caused through neglect or improper inspection of the air brake equipment. Particularly Lawrence Wilcox (Westinghouse Air Brake Company) stated that four points which cover some of the more important features of air brake maintenance in which car foremen are directly interested and which are important factors in wheel damage are improper levers, proper maintenance of triple valves, a sufficient piston travel to eliminate excessive brake cylinder pressure for a given brake pipe reduction, and failure to make certain that the small exhaust port in the retaining valve is open when cars are on repair tracks, the percentage of these cases running as high as 35 per cent.

E. H. Mattingly (B. & O.) stated that the relationship of the triple valve with the brake burned wheel or the heated wheel is a very serious one and that it is the duty of the owners of cars to see that the triple valve is put in the best condition possible. Mr. Mattingly also laid stress on the importance of having minimum and maximum standards of adjustment of side bearing clearance.

Representatives of private car lines stated that the 625-lb. wheel was too light for refrigerator service, which includes high speed work with heavy breaking wear, but as the M. C. B. standards specified this weight for the type of car used, the private owners had no protection on the exchange of wheels should they adopt a heavier standard. It was generally agreed that a heavier wheel, weighing about 740 lb., would give increased efficiency in high speed freight cars of this type.

E. S. Way (General American Tank Car Company) stated that many wheels are removed for brake burns and chipped rims which are not at all dangerous and have a great deal of mileage left in them. He advocated closer personal instruction of shop and yard inspectors as to what constitutes a dangerous wheel.

A committee was appointed to look into the cause of wheel defects and report their finding, together with a recommendation for heavier wheels on refrigerator cars, to the American Railroad Association.

The Aeroplane Engine in Industry.—That the airplane engine is not above ordinary humdrum work is shown by the fact that one has recently been installed in a London factory as a stand-by power unit. It burns gas instead of petrol and the cooling water is circulated through a common cast-iron radiator. It is an eight-cylinder engine, surplus from the war, and at the aerial rate of living would develop 200 hp., but has been rated at 75 hp. on earth to give it a reasonable length of life.—*Compressed Air Magazine.*

Inspecting Cars in Interchange

Methods to be Followed to Comply Fully with the M. C. B. Rules and to Locate All Important Defects

The following suggestions are for the purpose of educating and impressing upon the minds of all inspectors and follow-up men the practices to be observed in their everyday duties and to bring about uniformity of inspection.

The first duty of the inspectors is to be in the yard when the train pulls in, to see if they can detect, as the train passes, by sound or sight, any defect, especially of the truck and wheels, which would not be detected when car is not in motion, and checking such equipment with a mark so that it will immediately come to their attention when they reach the car in their regular duties. Contrary to this, many inspectors remain in their buildings until the road engine cuts off, which indicates that the inspector does not have the proper spirit nor take the lively interest in the work that he should.

Before going over the train, as he reaches the end of the string of cars the inspector should be absolutely certain that the blue flag or blue light is on each end of the string.

The method of inspecting a car should be as follows: On reaching the end of the car, the two ground inspectors must view all parts on the end of the car, including the couplers, carrier irons and outward parts up to the roof. They should then look beneath the car at the outer pair of wheels to inspect the brake beam, connections, bolster, draft rigging, sills, etc. They should next advance to the inner wheel, making a similar inspection of all parts under the car and before advancing to the center of the car for door inspection, etc., should cover the complete side of the car including side ladders, raising all box covers to see that the packing, brasses and wedges are in good condition and, above all, be extremely careful in inspecting the truck sides, arch bars, etc. The inspectors should then pass on to the center of the car, stooping to examine all truss rods, cross tie beams, vital parts of the air brakes and brake connections and repeat the same performance on the other end of the car.

OVERHEAD INSPECTION

The overhead inspection is usually covered as a whole, by a special man going over the top of the string in advance of the ground men in some yards, but the most thorough inspection, with the best results, is secured by having the overhead inspection made in the presence of the ground men, so that the hand brake can be set up and tried by the overhead inspector, and the two ground men can observe that everything is in good condition. It is strongly recommended that this practice be carried out to give a more perfect overhead inspection, not neglecting the lateral and longitudinal running boards and all parts of the brake staff, including the brake step-board, ratchet and other parts, and the usual careful attention of the roof handholds.

On open-top loaded cars special attention must be given to the condition of the load; where it is loaded with bulk commodities, such as coal, etc., it must be observed and depressions recorded that would indicate loss. On cars loaded with boxes, cases or other parts, the overhead inspection should include the condition of bracing and blocking and general method of securing the load and damage and breaking that may be observed on the parts.

On open-top, empty cars, special attention must be given to the inside cross braces, the condition of the floor, and where any refuse is left in the car it should be had ordered for cleaning.

On empty box or other closed cars, before classifying for loading, an interior inspection must be made for leaks through the roof, floor and siding, stains or odors of oil, fertilizer and other objectionable matter; refuse of material that will leave such stains or odors injurious to grain or flour. Cars with such defects and otherwise physically fit should be classed for rough freight or merchandise loading.

INSPECTING THE BODY OF THE CAR

The center sills or channels, extending from end to end in the center of the car, to which the draft gear is attached, should be in perfect condition to withstand the pulling and buffing stresses. The draft timbers are attached to the center sills by bolts to support the coupler and attachments, and it is necessary that these timbers be tightly drawn up to the center sills to prevent movement back and forward thereby elongating the draft bolt holes in the center sills and consequently weakening the sills.

In wooden cars the end-sill extends across the end of the longitudinal sills, retaining the longitudinal sills in position. The end sill also holds the body truss rods and distributes buffing shocks of all the sills.

The body bolster, commonly called body transom, connects and retains in position the longitudinal sills over which the weight of the load is distributed. Fractures in this member usually develop in the center, near or at the center plate, rendering the bolster liable to collapse, causing contact of the side sills with the truck sides or frames and severe binding at the side bearings, and also causing the possibility of derailment.

The cross tie timbers, and body truss rods support the car at the center and should be kept in good condition, insofar as retaining the truss rod castings in place is concerned. The rods should at all times be tight to prevent sagging of the car in the center when loaded.

The coupler should at all times be maintained in first class condition and should, therefore, receive careful inspection and attention with respect to the proper contour of the coupler head and knuckle, also to see that the lock and parts, knuckle pin, uncoupling lever and parts are in good condition and always operative. A test should be made by inspectors of the uncoupling device to determine its condition, also of the knuckle pins, defect in which are usually easily discernible.

The coupler yoke rivets, by which the coupler is secured to the yoke, must receive careful attention, as these are very essential parts. When found defective they should be condemned for immediate repairs, depending upon the number remaining effective and the coupler yoke having a gib. Failure of these parts causes considerable damage to sills and draft gear.

The carrier iron is attached to the front end of the draft timbers supporting the coupler and allowing lateral motion, also preventing the spreading of draft timbers. The bolts holding it in place are very essential in order to maintain proper coupler height.

DEFECTS OF TRUCKS

Trucksides and arch bars are the foundation of the car and are designed of sufficient strength to support the weight of the car, plus the weight of lading the car is supposed to carry. A fracture or crack reduces the margin of safety to such an extent that the part is liable to break off with added strain or motion. The fracture usually occurs at the lower web of the arch, as the greatest weight is distributed to that point by its construction. This should not confine the examination to this point, however, as the arch bar or truck side is frequently broken at the top or other points.

The bolster is the key to the truck, distributing the motion in curving, binding the two sides, and absorbing the greatest shocks of irregular track. A broken bolster may cause the truck to collapse or the body to fall down on the truck sides. The fracture usually occurs at the center or near the spring seat.

The spring plank is a secondary binder of the two sides and a fracture may cause the collapse of the truck. Fracture occurs mostly at the spring seat, in modern type of truck.

Broken journal boxes should not be allowed to run as they cause loss of lubrication, misplacement of the journal bearing and consequent cut journals.

The truck column and journal box bolts and nuts are used to tie the various parts into one piece. The loss or looseness of the nuts of such parts may cause the bars to spread, by taking away the strength of the arch, tie scraps to fall down on the track, or the journal box to slide out of the arch, causing derailment. Special attention must be paid to these parts on all repair tracks and in all yards.

DEFECTS OF WHEELS AND AXLES

Flat sliding (Rule 68): A wheel slid 2½ in. or over in length, or one with adjoining spots 2 in. in length, produces a continuous pound with each revolution of the wheel. This pound is destructive to the rail as well as to the wheel itself and may cause either or both to break. This defect can best be detected when the car is in motion and should be looked for on incoming trains.

Broken flange, chipped flange (Rule 78): A wheel having a broken or chipped flange may mount the rail in motion and cause derailment. Measurements may be made with the wheel gage; the lengths from the journal collar notch to the second notch measures 1½ in.

Broken rim (Rule 70): A broken rim if inside the 3¾ in. limit reduces the surface of tread so much that the wheel may leave the rail. Measurements are made by placing the gage horizontally on the tread. When the break occurs inside the semi-circular slot, it is condemnable.

Shelled out wheels and brake burn (Rule 71): Shelled out wheels are distinguishable by comby spots on the tread. When such a single spot is 2½ in. or over in diameter, it will pound similar to a slid flat wheel with the same danger to the wheel and the rail. Brake burn is the first symptom of shelled out wheels. Hard and prolonged applications of the brakes having destroyed the chill, or hardened outer surface renders it subject to breakage.

Seamed wheel (Rule 72): A seam ½ in. long in the tread ½ in. from throat of the flange or 3 in. long, within 3¾ in. from the flange may cause either the flange or rim to break off and derail the car, by mounting or leaving the rail.

Worn through chill (Rule 73): Many inspectors call this "worn flat wheel." It shows up by a spot 2½ in. long or over, worn smoothly flat. This is caused by the hardened surface in the tread, known as the "chill" wearing through into the inner, softer metal of the wheel. This condition destroys the bearing surface of the wheel and renders it subject to breakage.

Worn flange (Rule 74): Wheels under cars of less than 80,000 lb. capacity 15/16 in. or less in thickness and wheels under cars of more than 80,000 lb. capacity 1 in. or less in thickness, ⅜ in. from the tread are condemnable. A vertical flange may not take this gage, but when the wheel is less than 80,000 lb. capacity, with a vertical flange extending 1 in. or more from the tread or on wheels of 80,000 lb. capacity or over extend ⅞ in. or more from the tread, the flange and tread contour are worn out to such an extent that the wheel may mount switch points or cause the flange to break off. Great care must be shown in the use of the gage in order to condemn wheels only when actually defective.

Tread worn hollow (Rule 76): A hollow tread may be brought about by an irregularity in the truck, or the improper mounting of wheels, or in other cases by long wear. The tread becomes concave, making the rim liable to break off.

Burst plate, hub or brackets (Rule 77-78): Wheels cracked outward by axle pressure and wheel plates and brackets cracked by expansion from severe brake heating are very dangerous, more especially so because of the difficulty in detection. Both the outside and inside plates must be most carefully examined.

Loose wheel (Rule 81): A wheel loose on the axle is usually caused by imperfect mounting. It is a most difficult defect at all times to define with certainty, but good and general indications are grease on the axle, hub or seat inside the wheel. Care must be exercised not to confuse grease with the paint used for mounting the wheel on the axle. This defect is most easily seen from the opposite side of the car.

Bent axle. An axle bent to any extent will shorten. The distance between the wheels, at one point of its revolution, and the tread of the wheel will not bear fully on the rail at this point, which may cause a derailment. This is a very dangerous defect and can best be detected while the car is in motion, when it is indicated by a jumping movement. If a car shows evidence of having been derailed the inspector should gage the wheels to test for bent axles.

Cut journals, hot journals and associated defects may lead to crystalization of the journal and breaking off, twisting off by burning and severe heating. This is one of the defects that causes greater delay to freight than any other item. Defective journals can most readily be detected immediately after the train comes to a stop by indications of heat and burning of packing. When this is not possible, or the journal has been cooled off and repacked, the face of the journal will show a blackened surface or the wheel plate will be smeared with oil. Such journals must be tested with the inspectors' hook, and if they show ridges, they should be cut out for truing up at the shops.

Brake beams, levers, hangers, connections, lever pins and cotters, brake shoes and keys, in order to perform the function for which they are put on the car, must be in place and properly secured. No part of the truck or brake rigging should be below 2½ in. from the rail. Worn cut pins, brake hangers, brake beam eyes, etc., should be renewed or shopped for repairs. Cotters should be spread to prevent dropping out. Owing to the fact that these parts are all connected with each other, the loss of one item may mean a further loss and many times may cause derailment; or the inability of the brakeman to stop the car may result in its entire destruction and loss of life.

SAFETY APPLIANCE INSPECTION

It is very important that close and careful inspection be made of all safety appliances to see that they are perfect in all details, as such parts are in constant use and must of necessity be free from defects both in parts themselves and parts that are used in application, having in mind at all times the requirements of the government insofar as proper size of material and location is concerned, regarding handholds, sill steps, ladder treads, etc. The inspection should be thorough in order to detect defects, particularly in the offset of handholds, ladder treads and sillsteps, to see that the brake pawl and parts are secure and engage the ratchet wheel.

Interchange and industrial inspection is a distinct and absolute necessity and so realized by all branches of the service, and the object of these suggestions is to concentrate our very best effort on keeping the inspection forces alive to their duties and thereby improve the service and overcome any negligence tending to lower the standard and warrant criticism.

STANDARD FREIGHT CARS PRACTICALLY COMPLETED

The orders for standard freight cars, placed by the United States Railroad Administration, have been completed, except for a very small number and have been allocated to the various railroads under Federal control.

The orders for the building of these cars were distributed, by the Railroad Administration, to the car building companies throughout the United States and were constructed with a speed and in a manner to reflect credit on the builders.

After the signing of the armistice many of the railroads were reluctant to accept allottments of these standard cars because of a falling off in railroad business and a considerable number of cars were held in storage for some months. However, business conditions improved considerably in the latter half of the year 1919, and practically all of these cars have now been distributed.

Of the total of 100,000 freight cars ordered by the Railroad Administration on May 1, 1918, but 16,636 remained to be built on November 8, and these were being constructed and put into service at the rate of over two hundred a day. By November 1 all the cars which had been completed and placed in storage on account of some of the railroad corporations refusing to accept the cars allocated to them had been stenciled and put into service, so that, from August 1 to November 8, 53,305 new freight cars had been added to the rolling stock of the railroads. Only 168 of those completed remained to be lettered, numbered and placed in service on November 6.

Tables of equipment purchased by Railroad Administration for the railway companies, showing contract cost, character, and allocation to the various railroads and attitude of railroads touching its acceptance.

FREIGHT CARS.

Name of railroad.	50-ton single-sheathed box.	40-ton double-sheathed box.	50-ton composite gondola.	55-ton hopper.	70-ton low-side gondola.	Total.	Total cost.	Corporation action. Accept.	Corporation action. Object.
Ann Arbor R. R.	300					300	$915,000		Yes.
Atchison, Topeka & Santa Fe Ry		1,700	1,000			2,700	7,659,300		
Atlanta, Birmingham & Atlantic Ry	200		150			350	1,014,550	Yes	
Atlantic Coast Line		950	300			1,250	3,582,150	Yes	
Baltimore & Ohio R. R.	2,000		1,000	2,000	500	5,500	16,018,000		
Bangor & Aroostook R. R.									
Bessemer & Lake Erie R. R.				500		500	1,408,500	Yes	
Boston & Maine R. R.		500	1,500			2,000	5,505,000	Yes	
Buffalo, Rochester & Pittsburgh Ry				800		800	2,253,600		Yes.
Carolina, Clinchfield & Ohio Ry	300			750		1,050	3,027,750	Yes	
Central R. R. of New Jersey	500			500	500	1,500	4,520,500		Yes.
Charleston & Western Carolina Ry		300				300	875,700	Yes	
Chesapeake & Ohio Ry	1,000			2,000		3,000	8,684,000		Yes.
Chicago & Alton R. R.			500			500	1,348,500		Yes.
Chicago & Eastern Illinois R. R.		500	500			1,000	2,808,000		Yes.
Chicago & North Western Ry	1,000	1,250	1,000			3,250	9,395,750	Yes	
Chicago, Burlington & Quincy R. R.		500	1,000			1,500	4,156,500	Yes	
Chicago, Indianapolis & Louisville Ry		300				300	875,700		Yes.
Chicago, Milwaukee & St. Paul Ry	2,000					2,000	6,100,000	Yes	
Chicago, Rock Island & Pacific Ry		1,000	1,000			2,000	5,616,000		Yes.
Chicago, St. Paul, Minneapolis & Omaha Ry		500	200			700	1,998,900		
Cincinnati, Indianapolis & Western R. R.									
Cleveland, Cincinnati, Chicago & St. Louis Ry		1,000		1,000		2,000	5,736,000	Yes	
Colorado & Southern Ry				300		300	815,100	Yes	
Delaware & Hudson R. R.	500			1,000		1,500	4,342,000		Yes.
Delaware, Lackawanna & Western R. R.			500	700	500	1,700	4,907,400		Yes.
Detroit, Toledo & Ironton R. R.			300			300	809,100		Yes.
Duluth, South Shore & Atlantic Ry									
Elgin, Joliet & Eastern Ry		500				500	1,459,500	Yes	
El Paso & Southwestern R. R.			250			250	674,250		
Erie R. R.	1,000		800	700		2,500	7,179,500		Yes.
Florida East Coast Ry	500					500	1,525,000		Yes.
Georgia R. R.	300		100			400	1,184,700	Yes	
Grand Rapids & Indiana R. R.	250		50			300	897,350		
Grand Trunk Western Ry		1,000				1,000	2,919,000		Yes.
Great Northern Ry		1,500				1,500	4,378,500	Yes	
Hocking Valley Ry			500			500	1,348,500		Yes.
Illinois Central R. R.			1,000	1,000		2,000	5,514,000	Yes	
Kanawha & Michigan Ry				500		500	1,408,500	Yes	
Kansas City Southern Ry				300		300	845,100		Yes.
Lehigh Valley R. R.			500	1,300	500	2,300	6,597,600		Yes.
Long Island R. R.			200	300		500	1,384,500	Yes	
Louisville & Nashville R. R.			1,000	1,000		2,000	5,514,000	Yes	
Maine Central R. R.	300					300	915,000	Yes	
Michigan Central R. R.	1,000		1,000			2,000	5,747,000	Yes	
Minneapolis & St. Louis R. R.		300				300	875,700		Yes.
Missouri Pacific R. R.		1,500	1,000			2,500	7,075,500	Yes	
Mobile & Ohio R. R.				100		100	281,700		Yes.
Nashville, Chattanooga & St. Louis Ry			200			200	539,400	Yes	
New York Central R. R.	1,000	1,000	1,000	1,000	500	4,500	13,070,000	Yes	
New York, Chicago & St. Louis R. R.		500				500	1,459,500		Yes.
New York, New Haven & Hartford R. R.				1,500		1,500	4,225,500	Yes	
Norfolk & Western Ry	800					800	2,440,000	Yes	
Norfolk Southern R. R.	200					200	610,000		Yes.
Northern Pacific Ry									
Northwestern Pacific R. R.		100				100	291,900		
Pennsylvania Co. (West) incl.	3,500		500	2,000	1,000	7,000	22,297,500	Yes	
Pennsylvania Co. (east)	3,000			1,000	500	4,500	14,287,000	Yes	
Pere Marquette Ry		500	500			1,000	2,808,000		Yes.
Philadelphia & Reading Ry	1,000			2,000	500	3,500	10,271,000		Yes.
Pittsburgh & Lake Erie R. R.	500				500	1,000	3,112,000	Yes	
Richmond, Fredericksburg & Potomac R. R.	500					500	1,525,000	Yes	
St. Louis-San Francisco Ry		1,500	1,000			2,500	7,075,500		Yes.
Seaboard Air Line Ry	500					500	1,525,000		Yes.
Southern Pacific Co.	1,000					1,000	3,050,000	Yes	
Southern Ry		2,000				2,000	5,838,000		Yes.
Spokane, Portland & Seattle Ry		300				300	875,700		Yes.
Texas & Pacific Ry									
Toledo & Ohio Central Ry		250		500		750	2,138,250	Yes	
Toledo, St. Louis & Western R. R.				350		350	985,950	Yes	
Union Pacific System									
Wabash Ry		1,500	1,000			2,500	7,075,500		Yes.
Western Maryland Ry	300					300	915,000		
Wheeling & Lake Erie Ry				1,000		1,000	2,817,000		
Assigned	23,450	20,950	19,550	24,100	5,000	93,050	271,360,000		
Unassigned	1,550	4,050	450	900		6,950	20,298,400		
Ordered	25,000	25,000	20,000	25,000	5,000	100,000	291,659,000		

SHOP PRACTICE

JIGS AND SPECIAL DEVICES IN LOCOMOTIVE REPAIR SHOPS

By J. C. BEVELLE
Tool Foreman, El Paso & Southwestern, El Paso, Tex.

In Figure 1 there are shown two flue sheet cutters, one for small boiler flue holes and the other for large superheater flue holes. The advantages in the small cutter is that the maintenance cost is very small on account of the cutter blade being made of flat bar stock and not requiring much machining. The blade is made of high speed steel similar to a counterbore and the cutter holder is made of a low carbon steel, hardened and tempered. The cutting edge of the blade is ground with a lip which makes it free cutting and curls the clips. This tool drills the hole in 40 sec. and stands up well under all conditions.

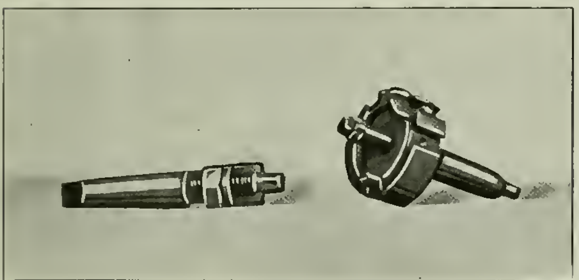


Fig. 1

The superheater flue sheet cutter is made so that it will cut all sizes required for superheater flues with one set of blades. With the milled places in the cutter body as shown in Fig. 1, it is only necessary to remove the blades and place them in the desired set of slots, which have the diameters stencilled on them. This cutter is made to cut two sizes but has space for one more set of slots. The cutter so designed eliminates the many different kinds of blades and different sizes to be carried on hand as the one set of blades will cut any size wanted by transferring to the proper slots. The blades are made of high speed steel and the cutter body is made of machine steel.

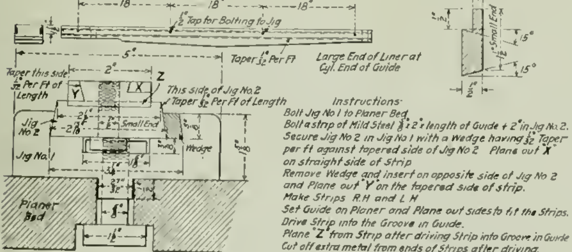


Fig. 2

The construction of jigs used in reclaiming locomotive guide bars, is illustrated in Fig. 2, which is self explanatory. These bars are reclaimed by planing a dove-tailed slot on each edge of the bar and applying an iron strip planed to suit the slot, then planing it off to size, bringing the guide bar back to standard size. This has proved to be a great success and all guide bars are being so reclaimed. After the bar has been planed out, if the strips are worn out, new strips can be applied and the life of the bar is prolonged indefinitely.

Fig. 3 illustrates the method of milling throttle lever quadrants on a universal milling machine. The quadrants are placed on a jig as shown, and held in place by the dividing head, the length of the jig giving the proper radius for the quadrant. The cutter is made with the proper pitch and the same radius as the quadrant and has 20 teeth. The

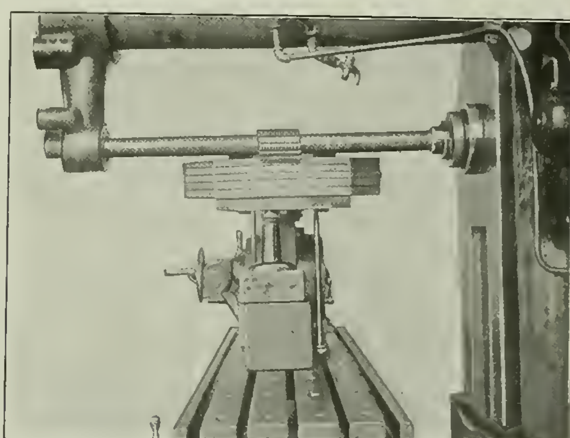


Fig. 3

quadrants are placed on the jig, six at one time, clamped down and the cutter put to work. The cutter finishes the quadrant teeth on the face as well as at the bottom of the tooth, making it unnecessary to turn the outside radius as it was when a single cutter was used. There being six quadrants on the jig at one time and twenty teeth in the milling cutter, 120 teeth are finished per traverse of the table of the machine. Six quadrants can be milled in one and one-half hours, or 15 min. per quadrant. The cutter is made of carbon steel and the dimensions are 3½ in. by 3½ in. with 1¼-in. arbor hole.

Fig. 4 shows a method of milling throttle quadrant latches with a cutter similar to that shown in Fig. 3. The latches are held in a vise, two rows, six latches in a row, making 12 latches completed in one setting of the machine and with two traverses of the table. The time for this operation milling the teeth in 12 latches is 40 min. or about 3 min. per latch. The cutter is 3 in. in diameter, 1½ in. wide, with a 1¼-in. arbor hole and is of carbon steel. The face of the cutter is formed, on the segment of a circle having the same center as that of the cutter for quadrants, giving the latch the proper radius on the face, allowing the teeth to fit each other and making a much better job than when the latch was milled straight.

A set of forging machine dies used for manufacturing superheater element tubes is shown in Fig. 5. This is done on a 2-in. Ajax forging machine. The tubes are of steel tubing and the end is upset with these dies in two

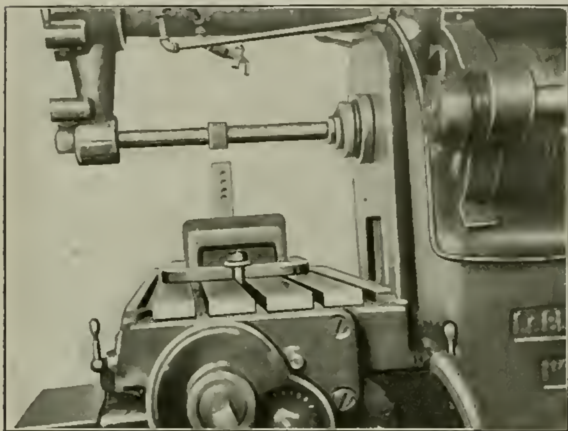


Fig. 4

operations and two heats. The first operation does about half the upsetting and the second operation completes the upsetting and forms the end to its proper shape. The tubes are then taken to a turret lathe and the ball joint is finished. They are then taken to the pipe shop where they are bent, threaded elbows applied, and bands applied. This shop manufactures all superheater unit tubes for renewals, and they have proved to be just as good or better than those

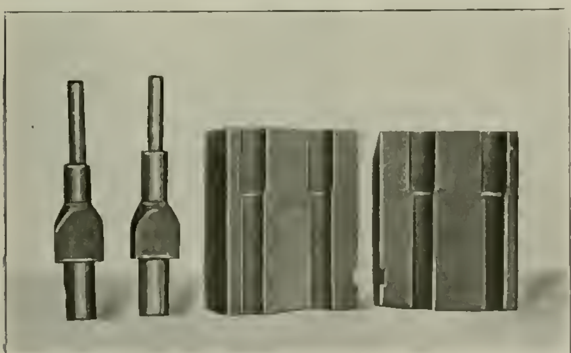


Fig. 5

bought and very much cheaper. These dies are made of machine steel and the heading tools are made of tool steel. The dies have been in service for four years and have made a large number of tubes.

A special prepared lubrication for air drills has recently been adopted on the E. P. & S. W. This consists of No. 2 compression cup grease and valve oil. The proportions are two-thirds cup grease and one-third valve oil thoroughly mixed together which gives a splendid mixture for air motors. The grease and oil are mixed with a butterfly paddle driven with an air motor. Air hammers are lubricated in a bath of coal oil and lard oil. The proportions are one-third lard oil and two-thirds coal oil. This is done at night when all air hammers are turned in to the tool room. They are allowed to remain in the oil all night, and if there is any dirt collected in the hammer or strainer it is dissolved by the oil which eliminates many repairs of the hammer.

Fig. 6 shows a method of machining the key-way in wrist

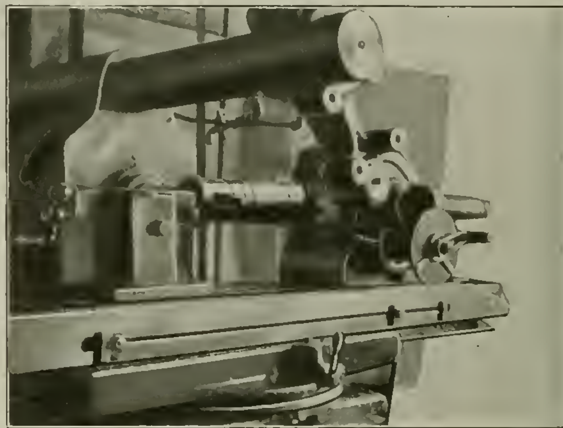


Fig. 6

pins on a universal milling machine, which is the same method used on piston rod key-ways. The key is milled with a radius cutter. The knuckle pin or wrist pin is first drilled with one hold and then milled, finishing the job. It is not necessary to touch the key-way by hand. Knuckle pins and wrist pins are milled in 10 min. each. The adop-

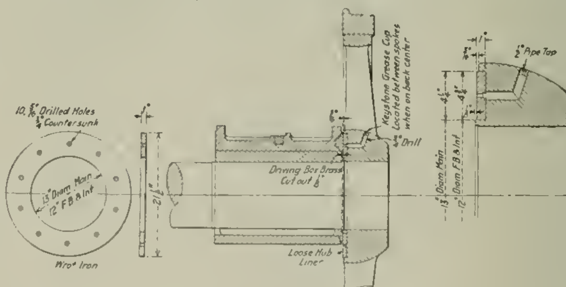


Fig. 7

tion of the key is so far better than the old method that we never apply a threaded pin.

It is the practice on this road to apply hardened steel bushings and pins on all link motion work. This has been our practice for many years and is very successful. The bushings are not ground on the inside after they have been hardened but are lapped out, making the hole as good as possible for the fitting of the pin. The pins are ground on a Brown & Sharpe grinding machine to fit the bushing. We don't know what it is to find a galled pin and our running repairs on this work are very light. It is rightly believed that after the bushings have been applied to the various rods, etc., that they should be placed on an internal grinding machine and the hole ground out to a standard size.

The pin can then be ground to have a more perfect bearing, giving the job a much higher effectiveness. Internal grinding in locomotive repair shops is somewhat new outside of the tool work but has a large field in the shop, and the sooner we admit this to ourselves the sooner we will overcome some of our troubles.

Fig. 7 shows the application of a floating hub liner. This liner is applied to a number of our Pacific and Mikado type engines. With this floating liner it is not necessary to shop the engine for lateral before it has made the required mileage which is 80,000 miles. On a recent date one of our Pacific type engines which has made 80,000 miles was put in the back shop for a classified repair, and on examining the hub liners and checking the lateral it was found that the lateral was 1/8 in. less than the limit, which is 3/4 in. A Mikado engine which made 65,000 miles was given the same inspection and found to be 3/16 in. less than the limit for lateral. The liners were scarcely worn at all and it was not necessary to renew them. This is becoming a standard liner on our system.

We must not forget that while manufacturing new devices and tools that in each case we should keep in mind the need of safety. The prevention of injuries should be considered even more than the efficiency of the tool or device. Do you ever inspect the tools that are in daily use in your shop to see that they are in a safe condition? The tool foreman should make this his business as he is more capable of determining the safety of tools. Our shop safety committee demands a report from the tool foreman on tools in all departments and this has brought about wonderful results in a decrease of injuries. The blacksmith shop, boiler shop, and even the different tool rooms are good places to find defective tools. Handle tools, chisel bars and chisels are very dangerous and are as a rule given very little attention. Safeguards on machines should be watched, grinding wheels should be daily inspected, the tool rests should be up in place at all times, the mounting of wheels should be watched very closely. There are numerous things in the shops and engine houses that are unsafe at their best and we must see that they are kept at their best and in a safe condition.

Efficiency in Railroad Shops*

The Importance with Increased Labor Costs of Improved Shop Facilities and New Machine Tools

BY FRANK McMANAMY

Assistant Director, Division of Operation

SHOP efficiency is a subject that is usually very closely associated in the minds of most of us with intensive production and stop-watch studies of the different operations in connection with shop output, and from that viewpoint it is a subject which can never be exhausted. There is no doubt but that a great deal has been and can be accomplished in that way in the matter of increasing production, although it is usually done at the expense of a more or less serious dispute with the workmen. I have sometimes found that while making time studies of shop operations with split-second stop-watches, we were overlooking conditions and methods where the time that might be saved could be measured with the hour-glass, and that we are, in many of our shops, using machines and methods that are as far behind the most modern and up-to-date practices as the hour-glass is behind the split-second stop-watch.

The transportation machine has, perhaps, been left by the war in more nearly a normal condition than any other industry for the reason that while it was worked to capacity during the war—in fact, most of the time was overworked—yet, owing to the limited facilities, it was not possible to greatly enlarge the plant and there are no greatly increased forces because both were impossible to obtain during the war. The increased transportation furnished represented almost wholly increased effort on the part of those producing transportation and increased output of existing railroad facilities.

The change which appears to be most important and far-reaching so far as the railroad shops are concerned, is the change in working conditions and the increase in the rates of pay of railroad shop labor both skilled and unskilled, and to my mind, this is a change which is permanent; therefore, it must be reckoned with in all calculations relating to the purchase or maintenance of shop equipment. These changes have made it essential to see that our men are provided with modern tools and improved facilities, because in no other way can operating costs be reduced and kept at a reasonable figure.

*Abstract of a paper read before the New England Railway Club.

The use of out-of-date tools and machinery in railroad shops—although never satisfactory—may have been in the interests of economy at the rates paid for labor before the war, but under the rates now paid the use of inefficient machinery is not only unsatisfactory but decidedly expensive.

It is a well-known fact that many railroad shops, together with their equipment, were at the time the railroads were taken over by the government, and are today almost hopelessly out of date, and that the methods which this lack of facilities makes necessary are such that no manufacturing industry operated on a competitive basis could practice and exist. In fact, it has been stated that $10,000,000 spent for shops and shop machinery prior to 1917 would have made it unnecessary for the government to have assumed control of the railroads. Whether or not this statement is true, it is a fact that one of the principal reasons for taking over the railroads was the condition of locomotives and cars in certain sections of the country which, together with insufficient terminal facilities and the effort of many shippers to use the cars as storehouses, caused such a congestion that nothing short of centralized control with complete authority could have met the situation.

A survey of the situation immediately following federal control showed many railroads hopelessly behind in the matter of repairs to equipment, due to their limited shop capacity, although it was proved that the total shop capacity of the country, if properly distributed, was sufficient to maintain the equipment. The inadequacy of existing shops and the character and quantity of shop machinery was one of the things that received immediate consideration from the Railroad Administration, and while it was impossible in the time at hand and under war conditions to start and complete large, new projects, the matter of providing additional equipment and facilities at existing shops received earnest consideration and vigorous handling.

Investigations of shops and shop facilities during this period confirmed a belief that many of us had that the importance of having shop facilities on any railroad keep pace with other improvements is usually neglected and frequently entirely overlooked. To promote efficient operation, grades are cut down, curvature reduced, terminal facilities are added, bridges and roadbed improved and strengthened to meet the requirements of new and heavier equipment, but the last thing that is given consideration—if, in fact, it receives any consideration at all until it is forced by the condition of power and terminal delays—is the question of providing shop and roundhouse facilities for the new and heavier equipment.

The general rule in the matter of making improvements is that if the saving to be brought about by the improved facility will pay the carrying charge on the investment, the improvement is a justifiable one, and under this rule, we have all seen locomotives and other equipment scrapped because of obslescence—that is because the work performed by the more modern equipment was sufficient to pay the carrying charge on the investment, and therefore, the additional investment was justifiable. Locomotives from 15 to 20 years old are either modernized by rebuilding or scrapped to make room for modern power, yet a trip through the shops on practically any railroad will show that we are trying to maintain this modern power with shop tools and machinery, much of which is more than 50 years old and which should have been replaced by modern equipment years ago.

I am familiar with the statements which will probably be made that the reason for failure to provide proper equipment in the shops is because of the difficulty of financing, but this does not cover the case because a check of the service performed by locomotives and the time lost at terminals will show that in many cases it would have been profitable to have spent the money that was spent for the last order of locomotives in providing shop facilities to maintain locomotives already on the line, and that if this had been done, the additional locomotives would not have been needed.

EFFICIENCY

Efficiency, as applied to railroad shops, is, therefore, the ratio of the shop output to the time, labor, material and capital expended. In order that a railroad shop may be efficient, it is necessary to have: first, suitable shop buildings with proper equipment and lay-out; second, an effective shop organization; third, necessary schedules so that the various departments of the railroad in any way related to the shop organization may be able to coordinate their efforts.

The efficient railroad shop must have as its fundamentals proper equipment suitably disposed and properly housed. It is difficult to understand, in view of the saving to be effected thereby, why we have so long failed to erect suitable buildings for shop purposes, and this not only applies to the car department where suitable buildings do not exist, but also to the locomotive department where the loss of output in decreased efficiency due to placing machines in badly lighted, poorly arranged buildings where unusual effort is required to deliver material to and from machines which are not accessible even to an ordinary warehouse truck, is really a very serious question. So far as possible, the travel of material through the shop should be arranged to eliminate back-hauls. The material should move in as nearly a straight line as possible from the foundry or smith shop to the locomotive or car. I have seen shops where driving box brasses were machined at one end of the shop and pressed into the box at the other end of the shop several hundred feet distant; then returned for boring.

When any new shop machinery is requisitioned at the present time, the purchase is objected to on the grounds of its high cost, and this argument has been very effectively used. We must now, however, consider this in the light of the comparative cost for machinery and labor, and when we consider the rate paid to shop labor at the present time, we will realize that in the life of the average machine, its cost will be paid many times by the saving in the time of the workmen, to say nothing of the increase in efficiency and shop output and the additional service obtained from locomotives and cars, which are often sorely needed.

A very costly part of shop operation is the handling of material in the shop. For that reason, crane transportation, where it can be installed, is desirable, and in any event, wide aisles for the trucking of materials should be provided.

Shop machinery should be located with a view to the use to be made of it, with machines or appliances for each particular kind of work in one group. For example, all the work belonging to the valve motion should be handled in one place. Similarly, driving box work and brake rigging work should be located in one particular portion of the shop.

Someone has said, "Information is the essence of efficient operation." Nowhere is this more true than in the proper conduct of a railroad shop, and generally speaking, in few places is information as to probable requirements so sparingly furnished. Locomotives sent to the shop for repairs which are said to require the removal of a set of flues are found to require fireboxes, and locomotives sent to the shop for fireboxes are found to need only a set of flues. It is of great importance that proper record of the condition of locomotives and cars be kept and the shops furnished as much in advance as possible with information as to the repairs which will be required on equipment destined for the shop within the next two or three months in order that the shops can provide the necessary material when the locomotive or car is placed in the shop, thereby avoiding the too common practice of having them occupy valuable space while waiting on material.

ORGANIZATION

Organization is defined as, "A systematic union of individuals in a body whose officers, agents and members work together for a common end." This is especially applicable to railroad shops where the ends sought are efficient production and minimum costs. While to some it may seem unfair that brilliant, individual performances should be submerged in an average, at the same time, whether in baseball or business, team work is essentially the thing that counts.

Without an organization embodying as well as implying co-operation, little, if anything, will be gained, and this is entirely up to the supervision. Each investigation made of points where shop output is unsatisfactory confirms the belief which I have long had that effective and constant supervision is necessary in order to obtain a satisfactory output. Quality as well as quantity in production comes from the top downward. The average workman will give you, in the matter of output, exactly what you are willing to take. If the supervision is satisfied with a minimum performance and low-grade work, that is exactly what they will get.

If we are to have efficient operation in any shop, we must have supervision that is constantly on the job, and will show that the officials and foremen are as much interested in both the quantity and quality of output as they expect the workmen to be, and that they are willing to aid in promoting efficiency by seeing that the workmen have: first, a suitable place to work; second, necessary tools that are as well maintained as they can be; and third, material and supplies promptly delivered so that the workmen will not be required to lose time waiting for their helpers to obtain material from a storehouse inconveniently located, or have to hunt it themselves from the scrap pile, or rob other locomotives or cars in order to obtain it.

An important factor in obtaining shop output is properly scheduling the work through the shop so that the work of the various departments may be properly co-ordinated and in harmony. Scheduling will have a decided influence to keep everything moving and avoid delays due to one department waiting on another, and these schedules should not be interrupted from day to day by switching in jobs of running repairs which could perhaps be better performed in the roundhouse.

Locomotive schedules must be made very carefully. It is almost as much of a task to make out a proper schedule for locomotives through the shop as it is to make out a time card for a division. Schedules that work satisfactorily in one shop will no more apply to another than a time card for one division can be made to apply to another A schedule once made must be carefully followed, or one gang or machine will be crowded with more work to be done at one time than it is possible to accomplish without increased facilities.

Locomotive schedules bear the same relation to getting work through the shop that time cards do to getting trains over the line. Every possible effort should be made to live up to the schedule, but when something goes wrong, the dispatcher in the case of trains, or the general foreman in the case of the shop, must take a hand, make new meeting points, or devise new methods, hold some work back and advance other; in fact, take whatever action is necessary until the business is straightened out again.

It is no more possible to keep every engine in a big shop moving on schedule time than it is to keep every train between New York and Boston on time. If it is found that locomotives are continually behind schedule, it may be due to two causes: first, the schedule may be too fast; or second, something may be wrong in the shop that needs straightening out.

A schedule of any kind is of very little use unless some real and earnest effort is made to live up to it in the regular operation of the shop.

EQUIPMENT

The equipment of railroad shops is an important factor with respect both to efficiency and output. It is not efficient to continue in service machine tools which have long since outlived their usefulness. A few conditions noted on a trip over a railroad which operates about 1,500 locomotives will, perhaps, explain more clearly than any other method of discussing the situation, the conditions I have in mind which must be given attention if we are to reduce shop costs.

The principal shop is an old structure that has been added to from time to time, and has no modern facilities or crane service. Locomotive driving wheels are removed on drop pits in the shop. On account of the length of the shop, when removing wheels from 2-10-2 type locomotives, they are moved over a pit and spotted with the shop locomotive, and two pairs of driving wheels are removed. The locomotive is then taken out of the shop to the roundhouse turntable about 150 yards distant and turned around, returned to the shop, and the other three pairs of driving wheels are removed. To handle these wheels requires all the men that can get around them. In re-wheeling the locomotive the same process is followed; that is, three pairs of wheels are applied to the locomotive, it is then taken to the roundhouse turntable, turned around and returned to the shop so that the other two pairs of drivers may be applied.

At another shop on the same railroad, in checking the movement of parts of locomotives from the stripping pit, it was found that the driving boxes, rods, cross-heads, driver brake rigging, springs, hangers, etc., are trucked through the entire length of the shop to the lye vat, a distance of 700 feet, and then distributed to the respective places for repairs, and finally returned to the point they started from. This movement of material which is trucked through a congested shop could be eliminated by placing the lye vat at the stripping pit and in re-grouping some machines in the shop.

The driving boxes move 1,900 feet from the stripping pit until returned finished. This could be reduced to 400 feet by re-grouping the machines.

At various other points on the same railroad, we found repairs being made with the following obsolete machinery and equipment:

Wheel lathe which was installed in 1878 on which it requires seven hours to bore a driving wheel tire which could be done with a modern, heavy duty boring mill in 30 minutes.

Tender truck wheels being turned on a 36-in. engine lathe in which but one tire can be turned at a time; therefore, the operation is very expensive. It requires five hours to turn tires which on a modern, heavy duty wheel lathe could be turned in 30 minutes.

Crown brass turning machine, built in 1861, which is entirely unsuitable for doing this work.

Wheel lathe, date of installation not obtainable, but is very old and requires seven hours to turn one pair of driving wheel tires and six hours to turn one pair of engine or tender truck wheels.

Wheel lathe, old type, which requires six hours to turn one pair of 50-in. driving wheels, and four and one-half hours to turn tires on one pair of engine or tender truck wheels.

Wheel lathe, which was placed in the shop in 1879 and was second-hand at that time. On this machine, it requires from three and one-half to four hours to bore one driving wheel tire.

At another point locomotives are used to haul a transfer table, and this practice has been in existence for about six years.

Planers of different sizes, built in 1864 and in 1867. These machines have but one cross rail head and no side head, and are entirely unsuitable for present day requirements.

On a mountain railroad with over 100 locomotives, a large percentage of which are Mallets, there is no wheel lathe. Tires are removed from the wheel centers and turned on a boring mill, and when necessary to turn the journals, the wheels are pressed off the axles and the journals turned in an engine lathe.

This list could be added to either on this same railroad or by going to any one of a number of others where this is fairly representative of their shop conditions, and when we consider that these and other similar machines must be used to maintain some of the heaviest, modern locomotives now in service, we will realize what some of the mechanical departments are up against in their efforts to maintain equipment.

Modern appliances are an absolute necessity, and it seems a shame that some of the up-to-date shops should be filled with hopelessly back-number machinery. In such cases, aside from improved facilities for handling, no decrease in the cost of machine work and no adequate output can be expected, and a road with such equipment will require a greater investment in motive power and cars to handle the business. The principal question is not how many locomotives a road has, but how many good, serviceable locomotives, and this depends entirely upon the facilities which the road may have for repairing them and keeping them in service.

Next to the machine installation, it seems to me that the problem presented in shop operation which is most deserving of study is the question of transportation of parts;

traveling cranes, mono-rail runways and jib cranes are wonderful factors in efficient shop operation, as they expedite the delivery of material.

MANUFACTURE OF PARTS

It is usual for railroad shops to purchase some material and manufacture other. In some shops, the manufacturing of material is a large portion of the work done. In others, the material purchased much outweighs the material manufactured. Of course, shops, generally speaking, are repair plants and not manufacturing establishments; therefore, if we are to manufacture material or parts, I believe that a sharp line should be drawn as between material or parts to be purchased and material or parts to be manufactured, and having decided what is to be manufactured, those in charge of the shop should prepare to do it in an economical and efficient manner.

The railroads have not as a general rule organized their mechanical departments on a manufacturing basis, but have depended upon outside sources for the majority of their manufactured products and such shop facilities as they have maintained have been largely for repair and maintenance work. Because of the diversified products of the ordinary railroad repair shop of today, the question of production has not been given the consideration it has in other fields. On some railroads, a start has been made towards the introduction of manufacturing methods by the establishment of centralized shop facilities which act as manufacturing plants for such commodities as can be distributed to outlying points where facilities for economical manufacture are not maintained. Such work, however, has usually been carried on as a side line at the largest repair shops on the individual roads. On this basis, it has been found economical to install special machinery and methods at a centralized point and manufacture pieces in quantities for storehouse stock to be distributed on requisition to the smaller shops or terminals over the system.

It is hardly to be expected that in railroad work, it will be possible to introduce the methods used in automobile manufacture or kindred lines, but it should be quite possible profitably to produce parts used in sufficiently large quantities at a centralized shop or manufacturing plant. Inasmuch as the finished parts for locomotives and cars are not designed to be absolutely interchangeable either in design or manufacturing tolerances, it is necessary for the most part to provide sufficient latitude to permit of the final fitting of each piece at the point where application is to be made.

During the past few years, great improvement has been made and is being made in the design of machine tools and special machinery for railroad shop work. The installation of automatic and semi-automatic machinery adapted for railroad shop uses has been extended. The introduction of modern high capacity and special machinery into railroad shops has not always been an economical procedure, however, because of the fact that the output of the shop where installed has not been particularly adapted to the machinery, or because in the average shop such machinery can only be used a part of the time for the purpose to which it is particularly adapted. If parts are to be manufactured on a substantial scale, it could probably best be accomplished through the establishment of centralized manufacturing shops equipped with up-to-date machine tools and shop equipment, with particular attention to automatic and semi-automatic machines for the production of locomotive and car parts in quantities.

One of the most important factors in the successful operation of a centralized shop for manufacturing purposes is the relation between the mechanical and storehouse departments. In order to derive the maximum or even satisfactory results from such an organization, it is essential that the shop be organized for quantity production on requisitions originating with the stores department; otherwise, we would be apt to have duplication of unnecessary parts and an accumulation of expensive manufactured parts which represent obsolete designs and have no value other than scrap.

With increasing cost for material and labor, it will be necessary to reorganize railroad shop facilities with a view to keeping equipment maintenance costs within reason; therefore, modern methods of shop production should be applied to railroad work in a much greater degree than is prevalent today. Locomotives and cars should be looked at from the viewpoint of a large investment, the productivity of which increases in exact ratio to the percentage which is available for service. It is usually estimated that the locomotives on a railroad represent approximately eight per cent of the total cost of the property, but it is this eight per cent which makes the other 92 per cent profitable, so that even assuming that by suitable shop facilities and efficient shop operation we are able to reduce our percentage of unserviceable locomotives from 12 per cent to 10 per cent, we have done more than the percentage figures indicate, since the amount of transportation which can be furnished by any railroad is represented by the number of serviceable locomotives which it has.

STEEL CAR REPAIRS

While it is true that there has been failure in many instances on the part of railroads to provide locomotive shop facilities, the situation is even worse so far as steel freight cars are concerned, and with the exception of a very few railroads practically nothing has been done along the line of facilities for the repair of steel freight cars. Where these facilities are provided, they are, as a rule, of the most meagre character; frequently home-made furnaces, which result in extravagant consumption of fuel, totally inadequate equipment of clamps, formers, etc., worn out pneumatic tools, an insufficient supply of compressed air and, in a great many cases, actual shortage of repair material is found to exist.

Hundreds of thousands of rivets are being cut by hand which could be cut by proper pneumatic appliances in a fraction of the time. With proper buildings, proper equipment and a sincere and determined effort on the part of those responsible, the steel car plant can and should be as well organized and as efficient as any portion of our repair facilities. It can be made so only by presenting to the proper officers, a list of needs, clearly showing the saving which will result from their installation, and if they are installed, by making efficient use of them. The only locomotive and the only car that earns revenue is the serviceable one.

Do not understand this as a criticism of the men in charge of the mechanical departments on the various railroads, except as it may be considered a criticism of their failure more aggressively to urge that adequate facilities more promptly and economically to repair equipment be provided. Neither is it intended to make us dissatisfied with what we have, because all must realize that we must do the best we can with existing facilities, however poor they may be.

It is rather intended to be an outline of existing conditions and is given for the purpose of directing attention to the importance of formulating and following a definite and progressive policy of railroad shop improvement, because under the changed conditions which confront the railroads at the present time, with respect to labor costs, if we are to keep shop costs within reason, efficient and adequate facilities for doing the work in the way of improved shops and shop equipment, particularly machine tools, must be provided.

The Casehardening of Steel

Generation of Gases Necessary to Caseharden; Composition of Packing Materials Important

BY J. F. SPRINGER

II.[1]

Sulphur is an objectionable substance which may occur in packings containing charred leather. Coke would also be a source of sulphur. It seems, however, that whatever sulphides form during carburization are limited to positions on the surface and would often be cut away in a subsequent grinding operation. However, where grinding or some other machine operation is not contemplated it will be well to bear in mind this possibility of a damaged surface on casehardened objects.

We have, in the foregoing, reasons to watch our use of granulated bone and charred leather or leather meal.

One of the best packings is the following mixture:

Wood charcoal (powdered)	3 parts
Barium carbonate	2 parts

The action of this preparation is understood to be as follows: The wood charcoal itself acts upon the metal, and in addition, the charcoal acts on the barium carbonate, producing the gas carbon monoxide (CO). The present mixture is very suitable where it is desired to produce a thin layer of impregnated steel that shall be highly homogeneous. When the packing loses strength it may readily be regenerated by simply leaving it exposed to the air in a thin layer after having recovered it from the boxes. The reason that this regeneration is possible is that the atmosphere always contains carbon dioxide (CO_2) in small percentages. When the barium carbonate ($BaCO_3$) is decomposed during carburization, barium oxide (BaO) is formed. Upon exposure to the air this barium oxide absorbs carbon dioxide and is accordingly transformed into barium carbonate again. *

$BaO+CO_2=BaCO_3$.

Barium carbonate is readily obtainable, in normal times, at prices in the neighborhood of five or six cents per pound. This should be sufficiently pure for carburizing purposes. Again, the natural form of barium carbonate, known as witherite and obtainable in crystalline, granular or columnar masses, may be substituted for the powder form of the artificially prepared substance. However, if the natural witherite be used, it is first to be ground and then mixed with the charcoal. If the artificial product is employed, the white powder may be mixed directly with the granulated charcoal and the mixture then ground to a powdered form. Barium carbonate, whether artificial or natural, is a poison, consequently, care should be taken in handling it.

It will be pertinent to reproduce here some experimental results, originally obtained it seems by the investigator Guillet. He varied the proportions of wood charcoal and barium carbonate, using 4:1, 3:2 and 2:3 mixtures. The steel was a very soft article, containing only about 0.03 per cent of carbon. The period of carburization was eight hours and the temperature 1832 deg. F. Two layers each 0.01 in. thick were analyzed and the local percentages of carbon ascertained. The following table gives the results.

Carburizing Effects of Mixtures of Wood, Charcoal and Barium Carbonate

Proportions		Carbon percentages	
Wood charcoal	Barium carbonate	External layer	Inner layer
4	1	1.14	0.75
3	2	1.32	1.19
2	3	0.94	0.77

I do not know whether Guillet previously heated the wood charcoal or not. There is reason to suppose, however, from experiments made by Nolly and Veyret that this preheating of the charcoal results in the more active production of carbon monoxide during the carburizing process, especially when the temperatures are high.

It may be as well to pause here and get a good glimpse of the carburizing action as now understood in the world of scientific research.

It is understood that a casehardening material acts though the gases emanating from it. Carbon alone will caseharden iron—but in a manner and to an extent that are of interest only to laboratory workers. Solid material operating without any assistance from gases has, from the point of view of actual practice, no effect. As we are, at present, interested only in practical matters, we note that the rule for us is: *Apart from the generation of gases, there will be no casehardening results.*

Further, in commercial work, it is understood that the gases do not act as mere carriers of carbon; or, if so, then only to a small extent. It is rather understood that the carburizing gas—which contains within itself the carbon—decomposes partially when it comes into contact with the highly heated metal. The carbon set free is absorbed by the metal, and the gas penetrates into the interior and there continues to decompose. This sets free additional carbon which is absorbed by the adjacent metal.

In actual practice, then, a substance must be supplied which when heated is capable of generating one or more carbonaceous gases and these gases must decompose as they penetrate into the interior of the metal.

Take the case of the packing material consisting of a mixture of pulverized wood charcoal and of pulverized barium carbonate. We are to understand that the solid wood charcoal exercises little or no direct influence on the metal. The heat has the effect of decomposing the barium carbonate ($BaCO_3$) into barium oxide (BaO) and carbon dioxide (CO_2). Here the carbon has only half as many atoms as the oxygen. Carbon in the form of wood charcoal enters into chemical combination with the carbon dioxide. The result is a gas in which there are as many atoms of carbon as of oxygen. This is carbon monoxide (CO). It is the real carburizing agent. As it comes into contact with the highly heated steel it seems partially to decompose and partially to go further in. As it gets in further, more of it decomposes, and so on. When carbon monoxide decomposes, free oxygen and free carbon are the result. Just what becomes of the oxygen, I do not know. The carbon enters into combination with the iron and forms iron carbide. There can hardly be any doubt but that this is substantially what takes place. This iron carbide is the cementite of the newly produced steel.

It will now perhaps not be difficult to understand that

[1] The first part of this article appeared in the November issue of this publication.

*During carburization, free carbon is present in the form of the wood charcoal. When the barium carbonate decomposes, the C and O_2 or else CO_2 given off is converted by this charcoal carbon into carbon monoxide. This gas is a powerful carburizing agent and is understood to be active upon the metal when the charcoal-barium-carbonate method is employed.

it is a matter of importance to know the gases which are given off by proposed packing materials and the relative amounts of carbon monoxide and similar gases.

Take wood charcoal for example. Between shop temperature and, say, 572 deg. F., the following gases will be evolved—carbon dioxide (CO_2), oxygen (O), carbon monoxide (CO), hydrogen (H), methane (CH_4) and nitrogen (N). These temperatures are entirely too low for carburization. Besides, the only gases produced in considerable percentages are CO_2, O and N. When the temperature of the wood charcoal has, however, been brought up, say, to 1,562 deg., F., the case will be somewhat different. Hydrogen becomes the principal product, but there is now increased relative amounts of CO and CH_4. Carrying the temperature on up to say to 1,922 deg., F., H. and CO become the principal gases evolved, the hydrogen predominating. That is to say, the CO now evolved amounts to about 20 per cent of the total being given off, while hydrogen amounts to some 73 or 74 per cent.

In short, the true agent of carburization (CO) is evolved, when the temperatures get up to casehardening levels, in very moderate relative amounts. Hydrogen is the plentiful gas. Even if we count CO and CH_4 both, for the temperature 1,562 deg., the combined percentage is only 21.3. At 1,922 deg., CH_4 is scarcely coming off at all. It should perhaps not be difficult to understand, after this disclosure, that wood charcoal alone is not much of a casehardening agent. It doesn't produce the thing wanted in sufficiently great relative amounts.

Suppose, now, we consider a table exhibiting at the temperatures 1,562 and 1,922 (fair limits for the casehardening range) the relative amounts of CO, H and CH_4 evolved by various combinations of wood charcoal and barium carbonate. Combinations 4 and 5 are understood to be identical with 2 and 3, respectively, except that in 4 and 5, the wood charcoal has been previously heated to about the boiling point of water (212 deg., F.).

Relative Volumes of Cases Given Off by Mixtures of Wood Charcoal and Barium Carbonate

Temperature	Gas	No. 1 Wood charcoal 90% $BaCO_3$ 10% Per cent	No. 2 Wood charcoal 70% $BaCO_3$ 30% Per cent	No. 3 Wood charcoal 50% $BaCO_3$ 50% Per cent	No. 4 Wood charcoal 70% $BaCO_3$ 30% Per cent	No. 5 Wood charcoal 50% $BaCO_3$ 50% Per cent
1562° F...	CO	28.1	25.3	30.8	42.2	28.4
	H	52.8	57.7	53.4	20.0	37.0
	CH_4 ...	8.7	8.7	7.0	2.0	1.2
1922° F...	CO	37.3	56 1	63.8	71.7	75.2
	H	60.0	32.0	28.0	15.0	12.0
	CH_4 ...	0.9	0.9	0.8	0.7	0.8

These results are understood to have been obtained by Nolly and Veyret. The percentage of CO given off at 1,562 deg. F., by the 50-50 mixture, the charcoal having been heated, seems anomalous. The loss due to the preliminary heating would be insufficient to account for the figures 28.4. Aside from this, the table shows pretty satisfactorily that the higher the percentage of barium carbonate, up to 50, the greater the relative amount of CO given off. The table also shows the considerable increases in relative amounts due to higher temperatures. Further, the preliminary heating of the charcoal appears to be beneficial. It is to be borne in mind that the percentages do not tell us the relative amounts of gases as between one temperature and the other, nor do they tell us the comparative amounts from different mixtures at the same temperature. They do tell us the relative amounts of various gases given off by one mixture at one temperature.

It will be well then to have before us in tabular form the relative total volumes of gases given off. Presumably these figures are comparable, for these total volumes, whether we attend to the rise of temperature for a single mixture, or whether, for a single temperature, we pass from one mixture to another. This data is also understood to be due to the same investigators.

Relative Volumes of Gases Set Free from Mixtures of Wood Charcoal and Barium Carbonate

Mean temperature	No. 1 Wood charcoal 90% $BaCO_3$ 10%	No. 2 Wood charcoal 70% $BaCO_3$ 30%	No. 3 Wood charcoal 50% $BaCO_3$ 50%	No. 4 Wood charcoal 70% $BaCO_3$ 30%	No. 5 Wood charcoal 50% $BaCO_3$ 50%
1472° F.	125	78	80	25	40
1652° F.	198	129	69	36	34
1832° F.	180	63	78	70	115

The following is a very simple mixture which appears to have given very satisfactory results. It seems to be superior to simple wood charcoal, but is scarcely the fine casehardening packing that the 3:2 mixture of powdered wood charcoal and barium carbonate is.

Wood charcoal .... 9 parts
Common salt .... 1 part

As to the apparent superiority over simple wood charcoal, one authority says: "for this it is not easy to give a scientific reason."

Other mixtures are:

I

Pulverized wood charcoal (oak).... 5 parts
Pulverized leather charcoal......... 2 parts
Lamp black ....3 parts

II

Pulverized wood charcoal (beech)... 3 parts
Pulverized horn charcoal........... 2 parts
Pulverized animal charcoal......... 2 parts

The authority Grenet is understood to recommend the following three recipes, all parts by weight:

I

Pulverized wood charcoal......... 10 parts
Common salt .... 1 part
Sawdust .... 15 parts

II

Coal (having 30% volatiles), pulverized .... 5 parts
Charred leather, pulverized........ 5 parts
Common salt .... 1 part
Sawdust .... 15 parts

III

Charred leather, pulverized........ 5 parts
Yellow prussiate of potash........ 1 part
Sawdust .... 5 parts

The rapidity of carburizing action is understood to increase from the first to the third of these mixtures. The sawdust is supposed to be advantageous because it makes the packing porous and consequently easily penetrable by the gases.

It will be well, I think, to quote some remarks by an authority on casehardening: "As I have already said, there are in use in machine shops numerous mixtures of the most varied and complex composition. The results of accurate and precise experiments do not justify, however, the use of such complex mixtures, which do not furnish results superior to those which are obtained with the less complicated cements; and, further, because of their complexity, do not furnish results which are constant or uniform and can be exactly predicted. The best and surest results are always obtained by using the simplest cements."

THE DAMAGED INTERIOR

The casehardening process is carried out within the range, say, of 1,472-2,012 deg., F. As the temperature level at which grain enlargement begins is 1,274 deg., it will be seen that the process necessarily involves over-heating and the consequent damage. There are, in general practice, two remedies for grain-enlargement—mechanical working, and re-heating. Naturally, the mechanical cure will practically never be available in cases where the exterior is casehardened. This leaves us with the heat-treatment procedure. One great advantage that the heat-treatment method has over the mechanical consists in its penetrative power. This, in ordinary practice, is often sufficient to make it preferable. Here, where no choice is permitted, the same advantage naturally obtains. Heat goes everywhere—into the interior, into big and small parts, etc., carrying its beneficial effects with it. On the other hand, the restoration of overheated steel by heat treatment is not equally successful with all the varieties of carbon steel. It is doubtless at its maximum of success when the carbon content is around 0.90 per cent. The steels generally used in work that is to be casehardened have carbon contents that are much below this figure. Probably the great majority have carbon percentages below 0.40 per cent. These are not the varieties of carbon steel that one would choose in order to display the effects of restoration by heat treatment. The reason is this. The annealing point for such steels runs up to temperatures considerably above 1,274 deg. These temperatures are to be attained, and yet every degree above 1,274 means further grain enlargement. Still, one has to deal with facts and not with wishes. While the restoration is not ideal, it is the thing to apply, because there is nothing else.

After the operation of carburizing has been completed, the work must be cooled below 1,274 deg. (medium cherry red), before applying the heat treatment. This is an essential point. There is a question, however, as to whether it should be cooled slowly or suddenly, and to this I will return later. Just now, let us master the essential point that the cooling must go below 1,274 deg. It matters not how far below 1,274 the cooling proceeds—the important thing is that it drops below. A black heat is good, especially as a black outside probably means—except for heavy work—an inside cool enough. Naturally, it is necessary that the interior as well as the outside cools off enough. Work made to cool down to shop temperature will certainly be all right, although this may seem a useless waste of heat, since the work is to be reheated.

But there is really no waste, or but little, for the reason that it is approved practice not to cool the work off slowly from the carburization point but rapidly. That is, the work is quenched. There is a partial exception to this. If the work has been carburized at a very high temperature (1,922-2,012 deg. F.), then it will be well to permit a slow cooling, say to 1,740-1,800 deg. and then carry out the quenching. The objection to the slow-cooling from the carburizing temperature centers on the possibility of the liquation of the ferrite and perhaps of the cementite as well, if the cooling is slow.

If there is any tendency to cracking, oil may be substituted for water as a quenching medium. Indeed, hot oil—with a temperature as high as 200 or 250 deg. F. — may be used and a still better correction realized.

There is still another quenching operation. This is the one which produces the hardening effect on the external shell. It is properly carried out at a temperature slightly in excess of 1,274 deg. — that is, at a full cherry red. Hardening can be done at higher temperatures, but why run the risks? The best practice everywhere in respect to the hardening of tool steel—and that is the kind of steel in the shell—prescribes hardening at a low temperature. However, Giolitti seems to sanction a hardening temperature for casehardening as high as about 1,470 deg. Whatever temperature is decided on. note particularly that it is not necessary that the interior be at this temperature. It is only the external shell that will be sensibly affected as to hardness by the operation now in hand, because that is the only part containing a high percentage of carbon. But, it is important that the surface heat desired shall exist everywhere. This is sufficiently obvious, once it is stated.

As to the choice of the exact temperature, it may be necessary to do a little experimenting. This is a very good rule to keep in mind when reading any statements as to the proper temperatures for all kinds of heat treatment operations. There are so many factors at work and these factors are so often variable that rigid statements that a metal will do thus and thus precisely at such and such temperatures are hardly permissible. The results may have been realized once with a certain piece of metal. The next piece that is tried may refuse to act as expected at precisely the temperature named; but may do so at a point a little higher or a little lower. The quenching having been carried out, one may then or later apply the heat treatment. This consists in heating to the annealing point proper for the carbon content, making sure that this heat has penetrated everywhere that restoration is desired, and then quenching the work. There will be more or less reduction of the grain size. The amount of this reduction will, it is understood, depend upon the maximum temperature of the re-heat. The more moderate it is, other things being equal, the greater the reduction to be expected.

The temperature of restoration for steels having carbon contents between 0.00 and 0.50 per cent may be taken to vary between 1,675 deg., F., and 1,425 deg. This is a temperature range of 250 deg. to be divided along 50 points of carbon variation. One readily gets the rule: *For every carbon point above zero, subtract 5 degrees of temperature from 1675 deg.* Thus if the carbon content is 0.08, subtract from 1,675 the product of eight and five, getting 1,635 as the temperature for the maximum of the reheat. If the steel be one having 0.20 per cent of carbon, subtract 20 x 5 giving 1,575 as the right temperature at which to stop the re-heating. Manifestly, if the case permits, we should choose a stock having as high a carbon content as would be available for the reason that it requires a lower re-heating temperature upon the re-heat, and this lower temperature is an advantage in the success of restoration. This is a matter that is probably very generally overlooked, since the eagerness to get a steel easily machined drives the choice to low carbon contents. The natural hardness of steel, not that produced by quenching, varies with the carbon content—the more carbon, the harder the steel. The choice of steel, however, should depend more upon the effectiveness of the restoration of quality than upon the ease of machining. In general, then, one should select as high a carbon content as is permissible, all things taken into consideration.

Having settled on the proper temperature for the restoration of the heart of the carburized steel in hand, the work is heated very slowly to the proper point. It is sometimes found that the restoration has to be carried out by heating to still higher points than those given and then quenching. This seems to be especially the case with steel of a very low carbon content. Thus, A. Portevin states that it is often advisable to quench from as high a temperature as 1,832 deg. F., "since the transformation into gamma-iron, which destroys the grain, is subject to retardations, like all polymorphic transformations."

The Temperature of Casehardening

The choice and control of the temperature at which the casehardening procedure is carried out constitutes one of the vital items of a proper technique.

Comparatively recent investigations show that the temperature of carburization affects both the rate of carbon penetration and the depth of such penetration. Martin-Siemens steel of low carbon content was employed in the form of square bars 1.6 in. by 1.6 in. in section and eight inches long. The particular packing material consisted of pulverized wood charcoal that had been treated with five per cent of potassium ferrocyanide and then mixed with an equal weight of barium carbonate in a dry condition. This may be regarded as substantially a half-and-half mixture of charcoal and carbonate. The following table and the accompanying curves exhibit the results:

EFFECTS OF TEMPERATURE ON DEPTH AND RATE OF PENETRATION

Number of hours in casehardening period	Penetrations in inches corresponding to temperatures				
	About 1292° F.	About 1382°-1436° F.	About 1562°-1652° F.	About 1742°-1832° F.	Above 1832° F.
12	0.030	0.044	0.078	0.098	0.106
24	.046	.064	.114	.148	.160
36	.060	.090	.146	.204	.232
48	.076	.112	.180	.236	.292
60	.088	.126	.212	.280	.338
72	.102	.144	.236	.312	....
84	.112	.158	.270	.348	....
96	.120	.180	.298	....	....
108	.132	.198	.324	....	....
120	.138	.218	.350	....	....

Referring to the curves, it will be seen at once that they do not cross one another. Each is altogether above the ones belonging to lower temperatures.

This means that when the temperature of casehardening is raised, the effect is to get a greater depth of penetration whatever the length of the period. This is a good general rule to remember. Again, splendid results, comparatively,

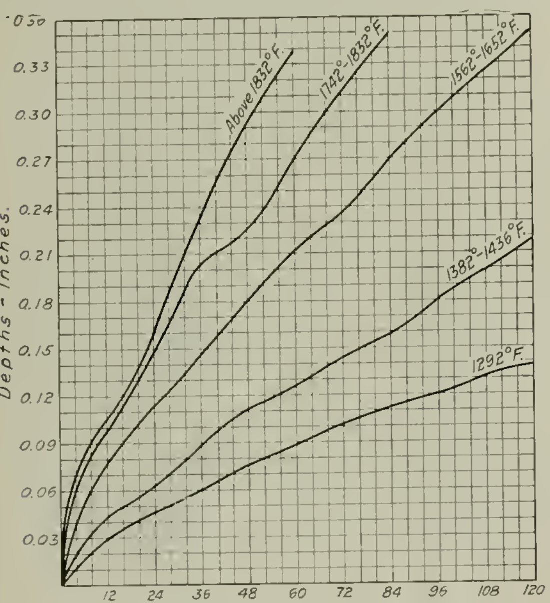


Chart Showing Relation of Time and Temperature to Depth of Impregnation

may be gotten with the temperature 1,562-1,652 deg. For general work, then, this is a good casehardening temperature. Raising the temperature quickens results, but except in special cases, hardly enough to warrant the practice. Good results are obtainable at temperatures below 1,562°-1,652°, so that, if there is need to use them, one may still expect results in a reasonable time.

Note especially that the curves are substantially straight lines. This means that the depth of penetration, at any given temperature of casehardening, is practically proportional to the length of the period. The simplicity of this rule gives it great practical value. If penetration to double the depth is wanted, then double the time will be required; if three times the depth, then three times the period, and so on.

DISTRIBUTION OF CARBON

It is of service to know the distribution of the carbon in the casehardened shell. Naturally, the local percentage of carbon falls off as the depth increases. Experiments have been tried for the purpose of getting at these facts. Probably, each packing material and each temperature of casehardening will affect this matter. Also, the period, the pressure inside the box, etc., will influence the distribution of carbon. It will, nevertheless, be useful to have some representative results before us: The packing material consisted of a mixture of wood and animal charcoal in the proportions of 7:3; the steel was a very low carbon variety (0.05 per cent); the carbon content of successive layers was determined after casehardening for 36 hours at 1,562-1,616 deg. F. The first layer was 0.2 in. thick; the following ones, 0.04 in. each. The carbon percentages for 12 layers, having a total thickness of 0.460 in. were as follows:

1.02, 1.00, 0.94, 0.66, 0.43, 0.22, 0.16, 0.14, 0.12, 0.10, 0.08, 0.07.

It will be noticed that the percentage of carbon in the steel fell off rapidly. This is, in fact, generally characteristic of casehardening. The high carbon steel is all located in a thin shell at the surface. However, by prolonging the period, tool steel (say, steel having more than 0.80 per cent carbon) may be produced to a pretty good depth. In the present case, the 0.80 per cent mark was reached at a depth of about 0.12 in.

It will be of interest to compare this with the results obtained on the same steel at the same temperature when the period was lengthened out to 10 times the original length—that is, to 15 days of 24 hours each. The carbon percentages follow, but the layers are, except for the first 0.02 in. of double thickness to what they were before. If one wishes to compare these results with the former, the missing percentages may be inserted. They may, in each case, be taken as the average of the pair between which the percentage is to have its place. They are as follows:

1.01, 0.95, 0.90, 0.85, 0.79, 0.73, 0.67, 0.62, 0.57, 0.52, 0.47, 0.43, 0.37, 0.33, 0.28, 0.25, 0.22, 0.18, 0.17, 0.15, 0.14.

The total depth of penetration here involved is 1.62 inches. If a curve be formed, it will be found to approach somewhat to a straight line. A curve for the former results (corresponding to 36 hours) would differ very considerably from such a line. This suggests the principle that the concentration of carbon falls off with a greater approach to regularity, the longer the period of casehardening. In the case of the 360-hour period, the increase of the depth by 0.08 meant, in the earlier part, a drop of five or six points in the carbon percentage.

In view of what is now known about casehardening, it seems permissible to state that, if the temperature is maintained at one level throughout the casehardening period, then he may with confidence expect that there will be no abrupt variations in the concentrations of carbon as the process penetrates from the outside towards the center. The rate of change may not remain the same, but it will not alter suddenly. This is a very important thing, since it enables us to avoid producing a shell or layer very distinctly different from the next above or the next below. Generally, abrupt changes in the carbon content of the steel are not desirable. All that we have to do is to maintain the conditions, especially the temperature, throughout the casehardening period.

CONTROL OF TEMPERATURE

Control of temperature—holding it at a given level—is much more easily specified than accomplished. A proper furnace is necessary and it must be capable not merely of producing the required temperature but it must provide a heating space where the fluctuations of temperature, as to various locations, are very slight. Good casehardening can hardly be done if the variations in temperature in different parts of the furnace—except, perhaps, for a space near the door, or some other special spot—are considerable.

Giolitti sets a maximum permissible variation at 30 deg. C. This is 54 deg. F. I will venture to say that there are any number of furnaces where this requirement is not met and where nevertheless casehardening, after a fashion, is being done. This evenness of temperature in the heat chamber is doubtless difficult to get where solid fuel is used, but a properly constructed furnace operated by oil or gas should accomplish the desired result.

A second prime requirement of the furnace is the capability of being run for long periods of time—up to 100 or more hours, depending upon the work—at the same temperature. This is another requirement that the furnace fired with solid fuel will probably find it difficult to satisfy. Oil and gas, however, when used in properly designed and constructed furnaces lend themselves to accurate regulation and should satisfy the requirement for an extended run.

A REPRESENTATIVE PROCEDURE

It will be useful to summarize for a representative case a good deal of what has been set forth. Let us assume that we have to caseharden a lot of small articles of low carbon steel.

1. Prepare the packing, making sure of its purity, fineness and dryness.
2. Prepare the box by casting the bottom with a fire-clay paste.
3. Heat the box or otherwise provide for drying this paste.
4. Tamp in place a bottom layer of packing 1½ in. thick.
5. Place one layer of the work on top of this layer, making sure that minimum space between articles and between the articles and sides of the box is 1½ in. or 1¼ in.
6. Put packing in and around articles and overlay them until the minimum depth of packing above tops of articles is 1½ in. or 1¼ in. Tamp the packing in place.
7. Repeat five and six for each layer of work put in.
8. Add a top layer of tamped packing to a depth of at least 1¼ in. or 1½ in.
9. Put top on, luting it with mortar of fire clay and water.
10. Set box, thus loaded, in furnace, but near door, until the interior moisture is all gone and the fire clay seal is dry.
11. Push the box into the furnace and bring temperature of boxes and contents to about 1,600 deg. F. There will be a variation between the center of the box and the exterior; 1,650 outside may be needed to get 1,600 inside near the center.
12. Maintain heat at an even level for the necessary time.
13. Remove box from furnace, open and suitably quench.
14. Re-heat slowly to restoration point.
15. Quench again.
16. Re-heat to proper hardening point.
17. Quench.

LOCOMOTIVE FAILURES

BY J. F. DONELLON
Master Mechanic, Delaware & Hudson

Locomotive failures, that awful nightmare to every conscientious roundhouse foreman, general foreman and master mechanic, can be given a knockout blow by applying the proper remedy in the roundhouse. If they cannot be eliminated entirely, they can be decreased to such an extent that the superintendent of motive power will wonder what happened.

This is what should happen: Cover the most important jobs in the roundhouse with specialists. The more specialists, the more efficient the organization will be. No matter how poor a mechanic a man may be, if he is interested in his work, he is bound to become more proficient if given regular work on a locomotive or machine. With the eight-hour day in effect and mechanics being paid while they eat, it is not asking too much to insist on 100 per cent efficiency.

It would be well for any master mechanic or shop superintendent to pattern his shop organization after a winning ball team—the master mechanic should be a good live manager, the general foreman or enginehouse foreman the captain, the gang foreman or leaders to be the coaches, training the players thoroughly, encouraging them when they are slipping and cheering them when they make a home run, or in other words when they do a good quick job.

Post the locomotive failure sheet, which in reality is a score board, every day. They will then quickly learn the items that cause failures and they will feel their pride hurt when fellow employees refer to some locomotive they worked on as failing between terminals and delaying other trains.

A careful analysis of the monthly failure sheet on any railroad will shown that 90 per cent of the failures are caused by improper inspection in the shops. Too much stress cannot be laid on the practice of educating locomotive inspectors, calling their attention to items that cause failures and giving them breakage diagrams of all the parts that fail, regardless of whether the locomotive on which the failure occurred was out of their respective station or some other station.

It is my belief that every rod, frame, link hanger, or in fact, any of the particular parts that fail frequently, have what I consider a breaking zone; that is, some part of the rod stands considerable more stress than the other sections and is more liable to fail.

A list of the parts that failed and caused locomotive failures on a prominent railroad is given below:

Air pump	4
Axle (driver) broken	2
Brake beam down (driver)	1
Brass broken (tank)	[illegible]
Bolts, eccentric hook gone	1
Brace, tank binder broken	1
Bolt, front side rod broken	1
Bolt, lost out back end of valve rod	3
Link saddle bolts broken	1
Rocker arm bolt lost	1
Cylinder head broken	2
Cylinder packing	2
Firebox door	1
Drawbars broken	1
Flues, superheater, leaking	2
Flues, bursted	4
Dump grates disconnected	1
Guide yokes broken	1
Leaky tank hose	1
Spring hanger broken	2
Driver hub cracked	1
Transmitter bar broken	2
Tender brake beam hanger broken	1
Link block hanger broken	1
Injectors not working	2
Hot tender truck journals	2
Hot trailer truck journals	1
Hot driver axle journals	7
Hot engine truck journals	3
Lining, front end main rod keys	1
Main rod key lost	1
Nuts off guide	2
Hot main pins	5
Broken air pipe	5
Packing rings, valve	1
Piston head broken	1
Plug out of release valve	1
Main rod working loose	1
Intermediate rod broken	2
Bolt blown out, reservoir	1
Reverse gear in back motion	1
Reverse lever casting broken	1
Low steam	2
Low steam due to leaky flues	1
Main rod strap broken	1
Relief valve spring broken	1
Strap on drawbar down	1
Tires loose	4
Throttle connection broken	1
Valve stem broken	1
Wrist pin nut lost off	1

This list extends over a period from January 1 to August 1, 1919. On this particular division there were 38,000 engines dispatched during this time, including yard engines and all classes of power, so there were approximately 430 engines dispatched per engine failure.

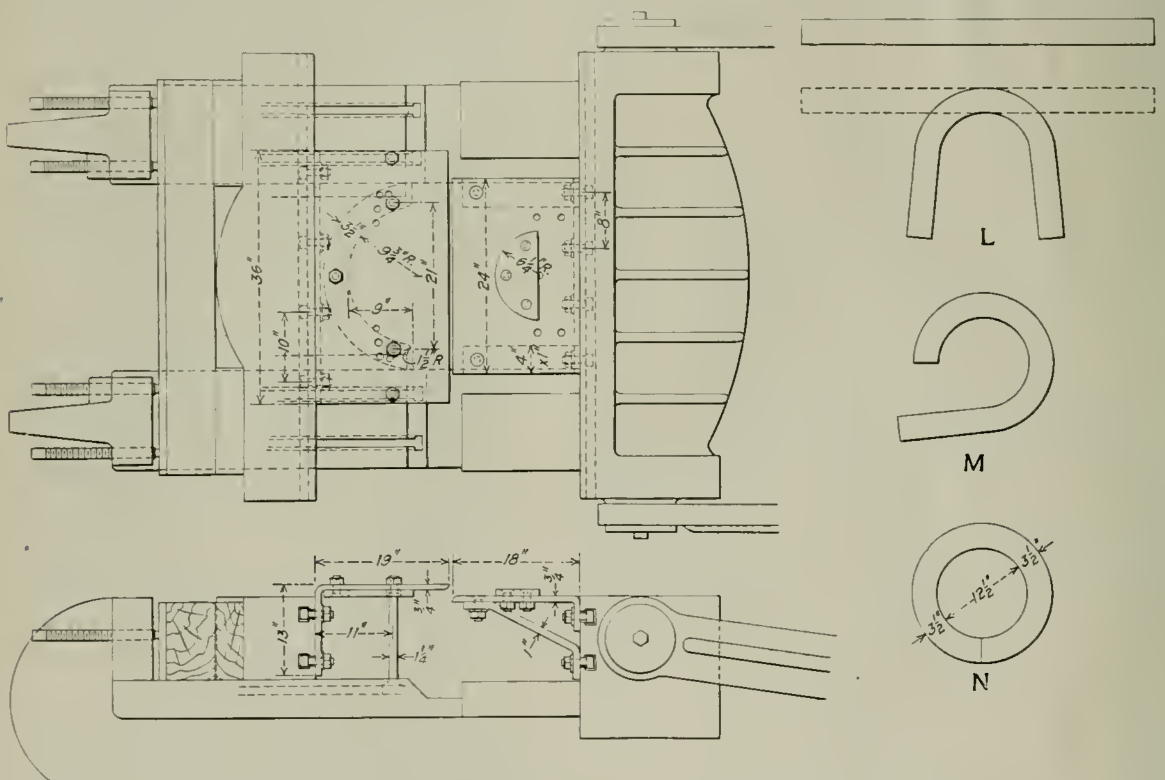
A careful study of the causes of failures, both by the mechanics and the inspectors, will add greatly to the capacity and efficiency of the roundhouse organization.

FORMING HUB LINERS ON THE BULLDOZER

BY F. G. LISTER
Mechanical Engineer, El Paso & Southwestern, El Paso, Tex.

On the El Paso & Southwestern there has been in use for some time a device for forming wrought iron hub liners for locomotive driving wheels on the bulldozer. This has proved very satisfactory as it forms a good hub liner at a very nominal cost. The device as applied to the machine is shown in the drawing. The dies *A* and *B* are made to correspond to the inside and outside diameters respectively of the hub liners, *A* being bolted to the top of one plate and *B* being bolted to the bottom of the other.

To form the liner, a piece of wrought iron 1 in. by 3½ in. and of the proper length to make a full circle is brought to a cherry red heat and laid across the bottom plate and against the periphery of die *A*. The first stroke of the bulldozer forms a piece similar to the shape shown at *L*. The iron is then moved until the center of the die is about one-fourth the distance from the end, and the second stroke of the bulldozer forms it to the shape shown at *M*. A similar operation on the opposite end at the third stroke forms the iron almost circular as shown at *N*. It is turned several times on the plate until a perfect circle is obtained and the ends join well together. The dies *A* and *B* are bolted to the plates ⅞-in. countersunk head bolts, so that they may be removed and other dies having different radii, depending on the diameter of the hub liner required, may be applied in their place.



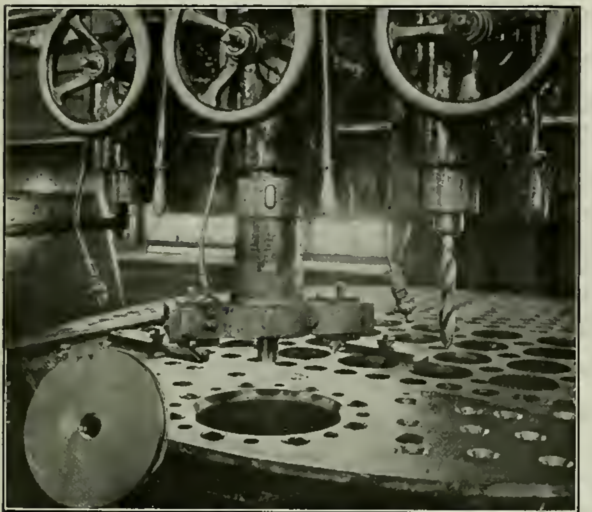
Details of the Bulldozer Dies and Sequence of the Operations for Forming Hub Liners

CORN USED AS FUEL IN ARGENTINA.—Because of the impossibility of securing coal from England, from which country Argentina formerly imported its supply, according to an article in the Railway Gazette (London), the demand for hard wood, obtained from forests in the northern part of the country, grew so rapidly that the railways found it difficult to haul to the south sufficient wood to supply themselves and other consumers. Experiments were then made with corn (maize), of which there was an abundance in the republic, and it was found that maize would burn freely and had practically the same calorific value as hard wood. It gave good results in the stationary boilers of power houses where thousands of tons were burned each month. Some was also used in locomotives. It was burned sometimes in the form of grain, but more often on the cob. Firebars had to be placed about ½ in. apart, otherwise the grain fell through into the ash pit or ash pan. This closing up of the bars was particularly necessary when maize was used on locomotives. In such cases it was burned mostly on shunting engines. The relative calorific values of maize and coal are found to be in practice as 2.5 to 1; similar values for hard wood and coal vary between 2.1 of wood to 1 of coal, and 2.5 of wood to 1 of coal. If the maize is ground down until the particles are about the size of those of a medium sand, and it is then blown by a fan into a heated combustion chamber, it immediately bursts into flame and is much more economically consumed. The maize sold for about $15 a ton and a large quantity is still being burned in the Argentine, but fuel oil in reasonable quantities is now arriving from the Mexican and other oil fields.

CUTTING DRY PIPE HOLES IN TUBE SHEETS

BY J. J. SHEEHAN
Tool Foreman, Norfolk & Western, Roanoke, Va.

The photograph herewith shows our method of drilling and facing front flue sheet for steam pipe joint. This tool



Tool for Cutting Dry Pipe Holes in Tube Sheets

fits the drill press spindle on the outside and is held in place by a key fitted to the drift slot in the spindle. The cutter heads are adjustable, having a range of boring size from 5 in. to 15 in. The size of steel used for tools is ⅝ in. by 1 in.

HOT DRIVING BOXES ON A. E. F. LOCOMOTIVES

BY C. E. LESTER
Shop Superintendent, Nevers (Nievre), France, Shops of the American Expeditionary Forces

In our repair work at the Nevers (Nievre), France, shops of the American Expeditionary Forces, among other things we experienced considerable trouble due to driving boxes running hot on one type of Consolidation locomotives immediately after leaving the shops after being overhauled. It was noticed that some 12 or 15 locomotives of this type had been sent to our shop within a few weeks' time to have the crown bearings renewed, and upon comparing the date of shopping and the date that the locomotives were built, it was found that they had been in active service only from one to three months.

When two or three of these locomotives had run hot after receiving new crown bearings, it was decided to watch the next one closely to determine the cause for this condition.

On the next locomotive received for repairs the driving boxes were removed, the crown bearings were shimmed, and in so doing several of them became out of parallel at the shoe and wedge face, making it necessary that these faces be planed. All the boxes were then bored to fit the journal, allowing enough to scrape them to a perfect bearing. The proper amount of clearance was given to the bottom ends of the crown bearings so that the oil would not have any difficulty in staying on the journal and that the box would not have a tendency to ride the journal.

In boring the boxes they were set on the boring mill on parallel strips with the hub face of the box up, to which they were lined with a surface gage so that the bore of the bearing would be at exactly right angles to the hub face. The boxes were then drilled and the bearings chipped, in order to have the oil from the oil cavity on top of the box distributed as evenly as possible over the entire surface of the crown.

The boxes were then sent to the erecting shop, applied to the journals, and checked by the erecting shop inspector, who found them anywhere from 1/16 in. to 5/16 in. out of center on the inside faces of the boxes. This condition existed on the boxes that had been planed, as well as on those that had not been planed, and on removing them from the journals and laying off a center on both the hub face as well as on the inside face of the box, it was found that the hub face was exactly in the center when compared with the shoe and wedge faces, but that the center on the inside face of the box was out of line the amounts stated above.

At this time we received in the machine shop another set of boxes of the same type, and before any work was done on them, centers were applied to both faces, as had been done to the other set, for the purpose of determining what their condition was when they were removed from the engine. It was found that these boxes also were out of center on the inside face of the box.

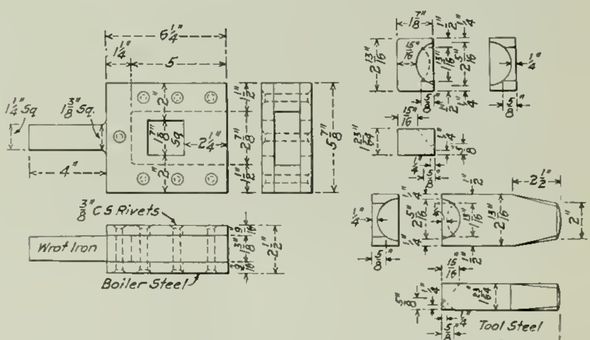
Previous to this time, when we had any of the boxes of this type in the shop to have the shoe and wedge faces planed, we clamped them down to the planer table on parallel strips applied under the shoe and wedge face, depending on which one was to be planed, which of course caused the box to be planed in the same manner as when it was placed on the planer, with the exception of having the faces running parallel lengthwise.

From the investigation made the opinion was formed that the hub face bore of the crown bearing and the shoe wedge faces were not square with each other when they were first built at the manufacturing works. This, we think, caused a twisting movement of the box, which had the same tendency to make the crown beating run hot as would a bearing with the crown bored tapering.

As we had no means of obtaining a casting of the proper dimensions to make a planer face plate on which the boxes could be clamped against the hub face, a large square was made, to which the boxes were set before planing the shoe and wedge face.

SHAPING THE ENDS OF TRACK CHISELS

In dressing track chisels the usual practice is to taper the cutting end under the hammer and term the edge to the



Details of the Track Chisel Sharpener

proper contour on a grinding wheel. This operation requires considerable time and unless care is taken the steel may be heated to such an extent that it cannot be tempered. In the Shoreham shops of the Minneapolis, St. Paul & Sault Ste.

Marie, an interesting device is in use which shapes the end of the chisel after it has been drawn down and makes grinding unnecessary. This combined shaper and sharpener is shown in the illustration herewith. It consists of a guide which fits on an anvil and holds two dies. The chisel after being drawn down under the hammer is inserted between the cutting edges of the dies and a single blow cuts off the end and shapes the edge. By this method considerable labor is saved and the danger of burning the steel on the grinding wheel is avoided.

A COVERED HOSE REEL

The covered hose reel shown in the illustration affords a simple and effective means of protecting fire hose from the elements and at the same time permitting easy access to the hose when it is necessary to use it.

The cover is made of sheet metal formed to cover the reel and the upper portion of the fire hose and is firmly secured to the reel standard, which can be permanently placed near a water hydrant.

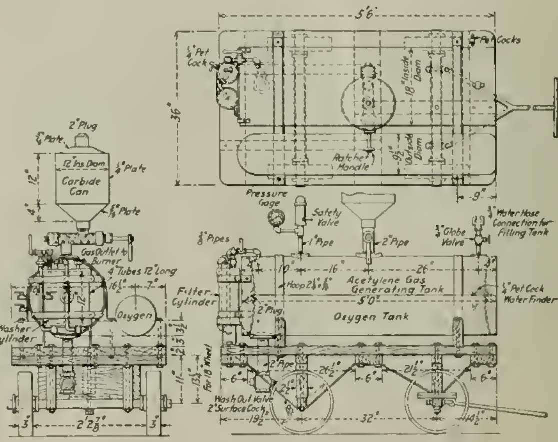
This cover can be easily and cheaply made in the shop

The Covered Reel Installed Near a Hydrant

and applied to hose reels about the yards. Its cost is not great and the protection afforded to the hose and to the reel itself will result in a much longer life of both. This effects an economy that will more than offset the cost of the cover and at the same time insures that snow or ice may not interfere with the use of the hose. This type of hose reel cover has been in use in the yards of an eastern railroad for some time past.

ACETYLENE GENERATOR, SACRAMENTO SHOPS, SOUTHERN PACIFIC

An old Pintsch gas tank or any other suitable tank that will hold a pressure of 50 lb. per sq. in. can be used for the generator. In generating gas the pressure should not exceed 12 lb. per sq. in. On the top of the generator is a reservoir to hold the carbide which is fed into the lower tank as wanted by a screw fitting in the inside of a two-inch pipe. The generating tank and washer should be kept about half full of water; the water level in the cylinders can be gaged by the use of pet cocks. The water level in the generator tanks should never be allowed to fall below the lower pet



Arrangement of Acetylene Generating Equipment

cock. The filter cylinder is to be filled with hair.

The gas from the generator tank enters the bottom of the washer cylinder, comes out of the top and enters the bottom of the filter cylinder from which it is drawn off through the hose and connections to the torch. Care should be taken to keep the carbide dry until used for making gas. At the end of the day, the generator tank should be washed out and fresh water put in both the tank and the washer cylinder. Every four months, or oftener if necessary, all plugs should be removed and the tank, pipes and cylinders should be given a thorough cleaning. No iron or metallic tools should be used in cleaning the tank. The contents should not be emptied into a sewer but should be deposited on the ground in some suitable location.

Diesel and Semi-Diesel Engines.—A Diesel engine is a prime mover actuated by the gases resulting from the combustion of a liquid or pulverized fuel injected in a fine state of sub-division into the engine cylinder at or about the conclusion of a compression stroke. The heat generated by the compression to a high temperature of air within the cylinder is the sole means of igniting the charge. The combustion of the charge proceeds at, or approximately at, constant pressure. A semi-Diesel engine is a prime mover actuated by the gases resulting from the combustion of a hydro-carbon oil. A charge of oil is injected in the form of a spray into a combustion space open to the cylinder of the engine at or about the time of maximum compression in the cylinder. The heat derived from an uncooled portion of the combustion chamber, together with the heat generated by the compression of air to a moderate temperature, ignites the charge. The combustion of the charge takes place at, or approximately at, constant volume.—*Compressed Air Magazine.*

NEW DEVICES

HIGH POWER TURRET LATHE

To meet the demand for a turret lathe of greater power and strength to finish gear blanks, forgings and tough alloy steel parts, the Warner & Swasey Company, Cleveland, Ohio, has developed the new No. 6 turret lathe, shown in Fig. 1. It is expected that on account of its increased power this machine will be able to do work formerly done by heavier and more expensive machines.

The increase in power and productive ability of the No. 6 turret lathe is secured by means of the double friction back gears, shown in Fig. 2. With the construction indicated, nine spindle speeds are available, three for each step of the driving cone. The extra power permits taking heavy forming and facing cuts on both bar and chucking jobs, which are beyond the capacity of the single back geared type of lathe.

The general view of the turret lathe shows it equipped with a heavy duty carriage provided with power cross and hand longitudinal feed. Six power cross feeds and reverse are obtainable in the apron. The three finer feeds are suitable for forming and the three coarser feeds for facing operations. The front toolpost, with an adjustable wedge, is arranged to be swiveled at any angle, and a cutting off tool holder is regularly furnished for the rear. Either of these tool holders may be removed and forming tool holders substituted. The automatic chuck and bar feed are provided, operated by a long lever in front of the head, and a stepped wedge automatically adjusts the collet for slightly varying diameters. A master collet and bushing pads are regularly furnished with the machine for holding $2\frac{1}{4}$-in. round stock, but bushings for hexagon stock can be held in this collet also. Square stock requires a square stock master collet and bushing pads. Extra capacity collets can be furnished for holding short-length work larger in diameter than the capacity through the spindle.

The hexagon turret is arranged for holding tools with or without shanks. The six tool holes, counterbored for centering plate tools, are fitted with draw bolts and are bored $1\frac{3}{4}$ in. in diameter, unless ordered otherwise. Bolt holes are provided for securing plate tools to the faces.

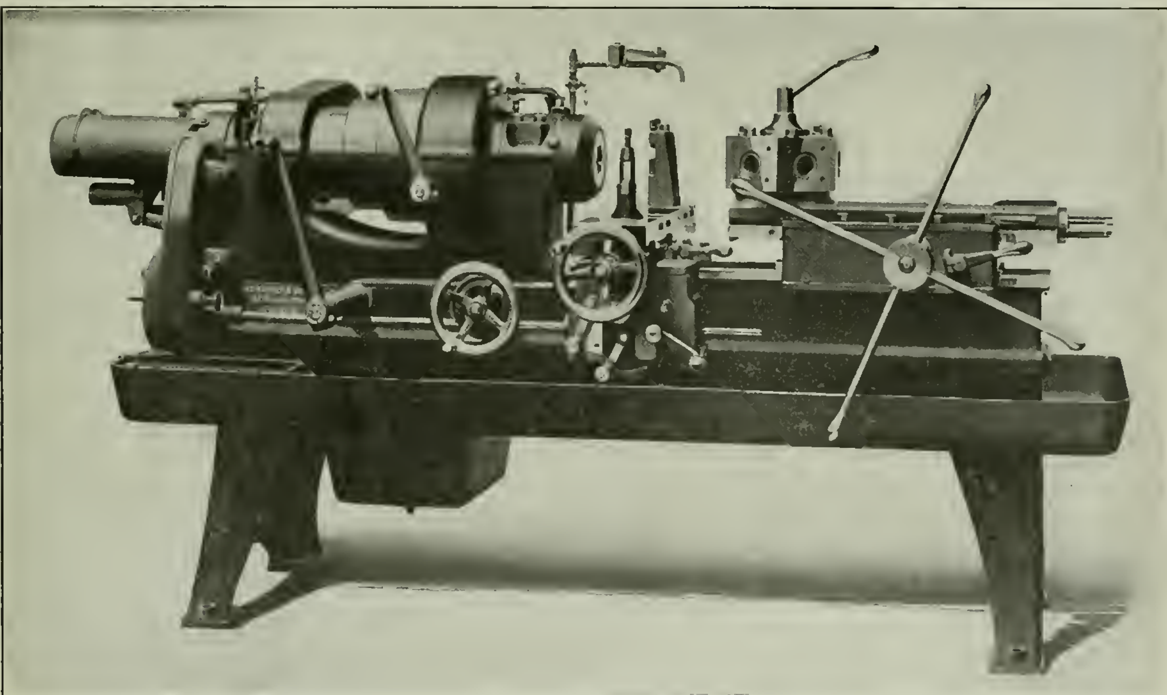


Fig. 1—No. 6 Warner & Swasey High Production Turret Lathe.

The turret is revolved automatically by the backward movement of the slide. The locking bolt is at the front end of the slide and works into steel taper bushings inserted in the bottom of the turret close to its outside edge directly under the cutting tool.

Independent adjustable stops operate automatically from each position of the turret and disengage the power feeds.

They are readily adjustable for the proper length of each cut.

The turret saddle has a supplementary taper base to adjust the tool holes in the turret to the exact height of the spindle center. Taper gibs, fitted the whole length of the saddle on each side, provide means for adjusting the slide sideways.

Power feed for the turret slide is furnished only when especially ordered, and any one of four feed changes is easily obtainable. The automatic trip operates in connection with independent adjustable stops for each hole in the turret.

An oil pump, which operates when the machine is run in either direction, delivers a steady and abundant flow of cutting lubricant to the cutting tools.

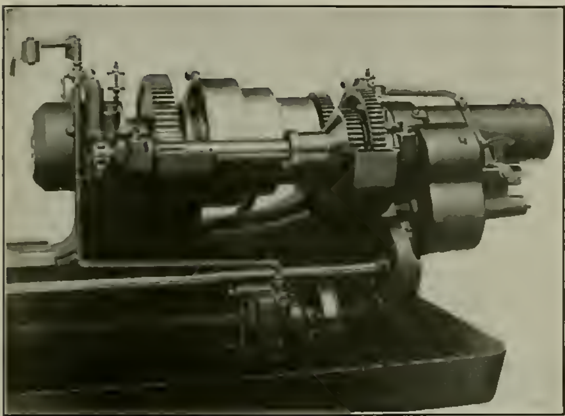


Fig. 2—Rear Head Showing Double Friction Back Gears.

The Warner & Swasey No. 6 turret lathe has a maximum swing of 20⅝ in. and a bar capacity of 2¼ in. On soft machinery steel the threading capacity with a self-opening die head is 1¾ in. The total cross travel of the carriage slide is 10 in. and the total longitudinal travel 14 in. A three-horsepower motor is required to drive this machine.

PRODUCTION FACE GRINDER

After being thoroughly tested over a considerable period of time a new self-contained face grinder, shown in Fig. 1, has been placed on the market by the Cleveland Machine Tool Company, Cleveland, Ohio. The particular advantages claimed for this machine are high production, freedom from breakdown and ease of operation. The L-shaped column is a one-piece box section designed for rigidity and strength. A door in front permits of easy access to the working parts of the machine for oiling, inspection and adjustment. The table is 42 in. long by 9¾ in. wide. One V-shaped and one flat way give ample bearing surface, and because of the fact that the table is larger than the ways the latter are always covered and kept free from dust and grit. The table is provided with a crank handle adjustment, as shown in Fig. 2, by which the arc of oscillation can be readily adjusted to the work to be ground. The throw, or arc of oscillation, can be adjusted up to six inches, which permits of handling work up to 12 in. in diameter. The table is oscillated by a crank disk, driven by a worm and worm gear, insuring a firm and steady motion. Six changes of feed are secured by means of a three-step cone pulley on the machine and a two-speed countershaft.

The grinding wheel head is fitted to a saddle, secured to the main part of the column by a dovetail slide, and gibbed to provide adjustment for wear. The adjusting screw for the saddle is provided with a micrometer dial. The grinding wheel head is pivoted and can be turned to any desired angle, thus permitting the use of wheels of various shapes. The head is graduated in degrees for a space of 30 deg.

The grinding wheel spindle is made extra large, of a special steel, hardened and ground, the bearings being of phosphor bronze. Large grinding wheel flanges are provided, and a wheel guard large enough to accommodate 8-in. grinding wheels is made a part of the machine.

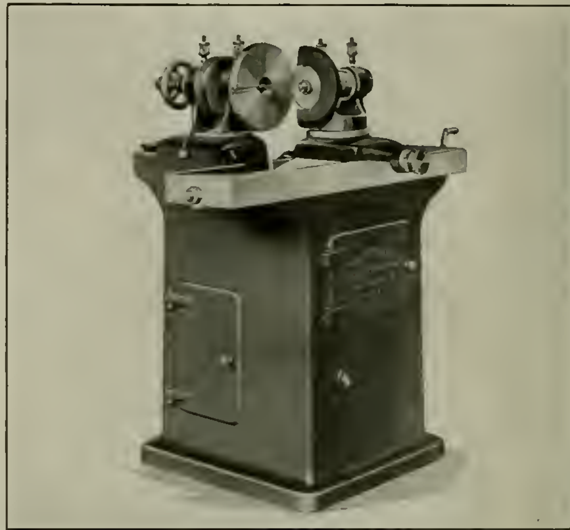


Fig. 1—Cleveland Production Face Grinder.

The work head is secured to the wing of the column by means of a dovetail slide and rests on its own saddle, which has longitudinal adjustment of 6 in. The saddle is attached to the column by a hand clamping screw, thus providing easy adjustment, and a gib makes this slide adjustable for wear. The machine will accommodate work 6 in. in thickness without overhang of the saddle. By making proper allowance for saddle overhang it is possible to handle work up to

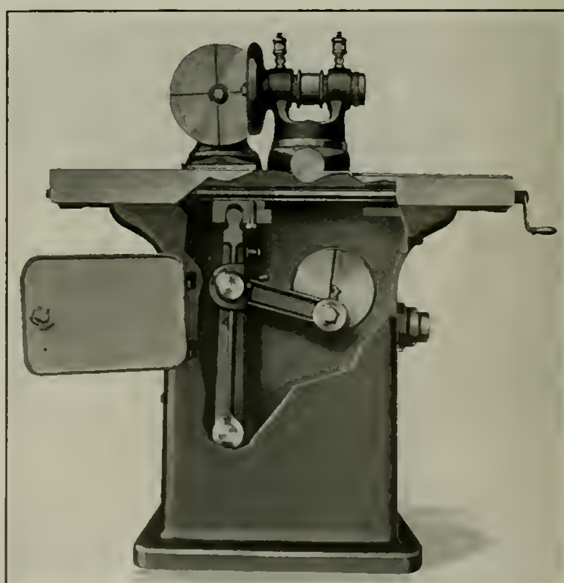


Fig. 2—The Arc of Oscillation Is Easily Adjustable.

10 or more inches in thickness. The work is pivoted on the saddle and can be swung to any angle.

The work spindle is extra large, made of special steel, hardened and ground, and has a No. 11 Brown & Sharpe taper hole. The spindle bearings are of phosphor bronze, and are adjustable for wear. The nose of the spindle is threaded to receive a 10-in. face plate, which has two 7/16-in. T-slots at right angles, permitting rapid clamping of the work. Careful consideration has been given to lubrication and protection from dust. The four spindle bearings are provided with large sight-feed oil cups, and all cylindrical and flat bearings have oil holes fitted up with dustproof oil caps. The machine is designed especially for grinding metal slitting saws, hubs of milling cutters, faces of bushings, arbor collars, etc.

HEAVY QUICK CHANGE LATHE

A powerful cone type lathe has been placed on the market recently by the Cincinnati Lathe & Tool Company, Cincinnati, Ohio. The lathe is made in four sizes, varying from 22 in. to 28 in. in capacity, and is designed especially with the idea of utilizing the best grade of high-speed steel tools

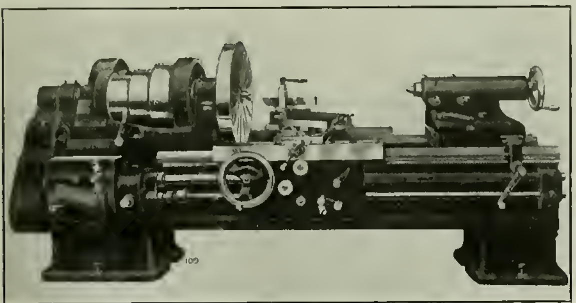


Fig. 1—Cincinnati Heavy Duty Lathe.

to their utmost capacity. The attempt has been made to design a lathe powerful in every detail and without intricate mechanism which may be easily broken or worn out.

The lathe bed, as shown in Fig. 1, is exceptionally heavy

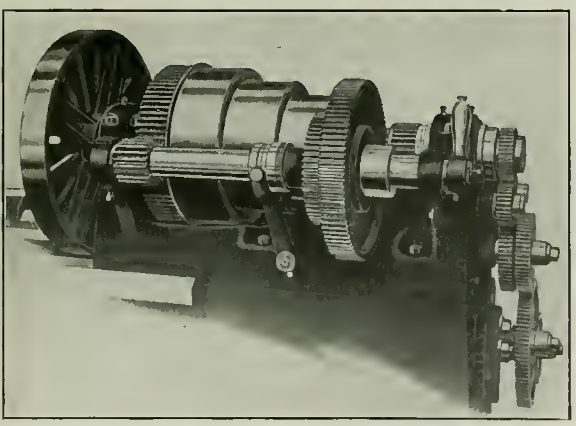


Fig. 2—Rear View of Sliding Double Back Gears.

and, being braced with box section girths, is well able to withstand all twisting strains. The carriage is especially designed to withstand all strains due to heavy cuts, and exceptionally long bearing on the ways is provided. This insures greater accuracy in the cuts taken and also reduces the wear. The apron, of box type construction, is provided with a chasing dial and automatic stop.

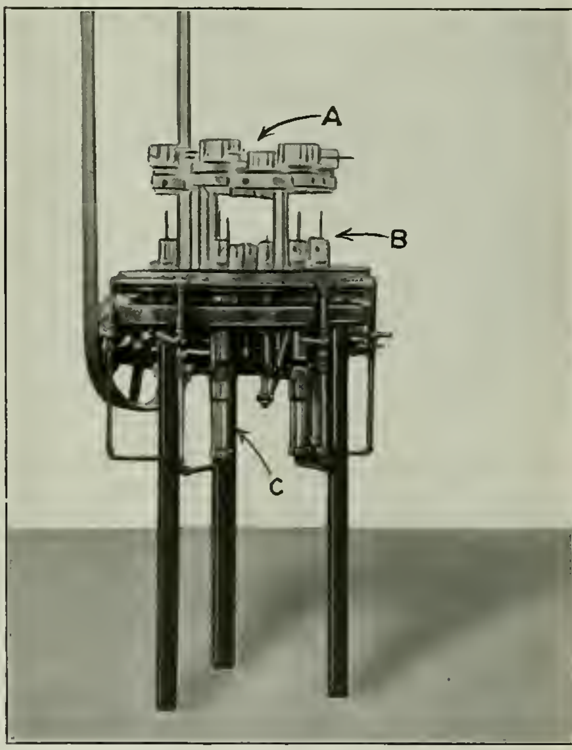
Ample power to drive this lathe is secured by means of the three-cone pulley, which is driven by a 5½-in. belt. The power is transmitted through the sliding double back gear shown in Fig. 2. An idea of the proportions of the headstock may be obtained from the bearings. The front bearing is 4½ in. by 7¾ in., the back bearing 3⅜ in. by 5⅜ in. The quick change gear box of standard Cincinnati construction gives a wide range of speeds and feeds.

The tailstock is equipped with a crank operated pinion, which meshes with the rack and insures easy movement of the tailstock. The two spindle locking devices for clamping the spindle hold it in rigid alinement and obviate the possibility of springing under heavy cuts.

If desired, this lathe can be furnished with turrets on the carriage or the bed, oil pan and pump, taper, relieving or draw-in attachments and turret tool posts. Either cone type or geared head for belt or motor drive may be specified.

STAYBOLT DRILLING MACHINE

Considerable difficulty has been experienced in drilling stay-bolt telltale holes, even before the bolts were applied to the boiler, due to drill breakage, and a five-spindle drilling machine has been especially designed with a view to obviating this difficulty. As shown in the illustration, the



Five-spindle Staybolt Drilling Machine.

machine is belt-driven, the driving shaft being geared to five drill spindles *B*, mounted in an equal number of small air cylinders *C*. Five chucks for holding the stay-bolts are supported on a framework, as shown at *A*. The chucks, which are self-centering and take all sizes of staybolts, are provided with a jig for supporting the drills.

By connecting the cylinders through the connecting pipes and three-way valves to the shop air line, the drills are forced up into the bolts when the three-way operating valve is opened. By drilling upward the chips may fall out easily, which eliminates a large proportion of the drill breakage. When the three-way valve is placed in release position the spindles drop, thus insuring a quick release. The capacity of the machine illustrated is 75 bolts per hour, with telltale holes 1½ in. deep, or 25 bolts per hour with telltale holes 8 in. deep. This machine is the invention of J. B. Hasty, San Bernardino, Cal., to whom a patent covering the principal features has been issued.

COMBINATION PUNCHING AND SHEARING MACHINE

During the past few years the general tendency in machine tool design has been to combine as many operations as possible in one machine and sometimes to combine the machines themselves. The result of this policy has been to reduce the cost of the machines, cut down the floor space occupied and render the operation of the machine more economical by the elimination of lost motion.

This principle of consolidating machines has been embodied by Joseph T. Ryerson & Son, Chicago, Ill., in a new quintuple combination punching and shearing machine. This machine has also been designed with the idea of obtaining maximum power, efficiency and simplicity of operation. Five metal working machines are combined in one unit, as illustrated in Fig. 1. The operations of shearing of plates, round and square bars, coping and notching, section cutting and punching may be performed without changing any of the tools or attachments; therefore no time is lost due to the interchange of attachments for the various operations. Samples of the work that can be performed are shown in Fig. 2.

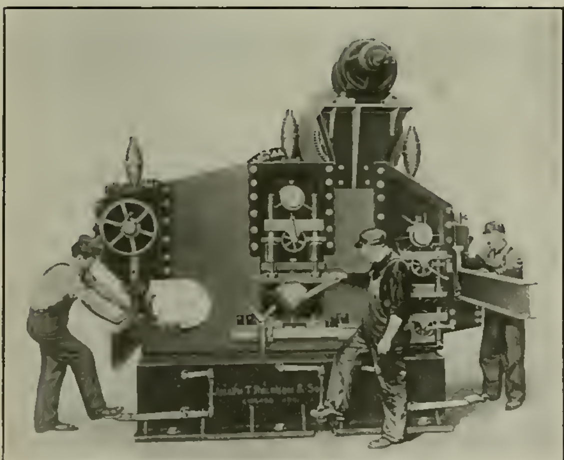


Fig. 1—Ryerson Quintuple Punching and Shearing Machine.

The operating side of the machine is entirely free from all overhanging machine parts, the entire mechanism, such as gears, clutches, fly-wheels, etc., being on the opposite side, as illustrated in Fig. 3. This constitutes a most important safety feature. Ample space is provided in order that the operators will not interfere with one another in handling different kinds of work at the same time. The section cutter especially is given generous space, so that the operator may cut material right or left handed, as desired.

All the foot-lever connections for operating the three clutches are arranged so that they do not interfere with long plates when passing through the full length of the machine frame in the splitting operation. This avoids the necessity for disconnecting clutch rods, as is sometimes necessary. The machines are furnished with heavy ribbed bases on both side to balance them properly and to insure a rigid foundation. The right-hand foot casting is cut away to provide necessary clearance for plates when cut in any length and width.

All machines are equipped with three-jaw automatic clutches for operating the sliding heads independent of each other. The automatic clutch on the front end is provided with a loose disk to permit adjustment of the stroke at any desired position. The clutch for the splitting shear, bar cutter and coping and notching machine can be operated by either hand or foot. The clutches for the punch and section cutter are operated by foot only. All gears except the motor gear are made of cast steel, having teeth from the solid metal. The gears run in extra long bronze bushings and are covered by gear guards, ample provision being made for lubrication. Heavily constructed outboard bearing brackets, illustrated in Fig. 3, take up all the strain when the three tools are operated at the same time.

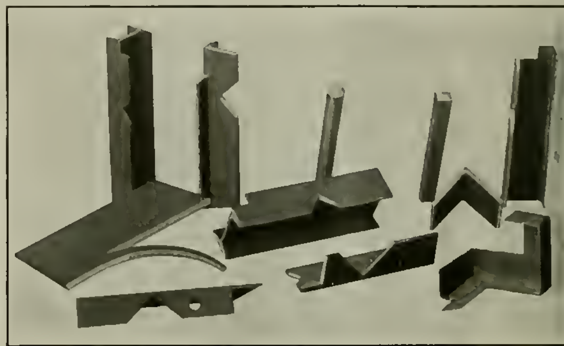


Fig. 2—Samples of Work.

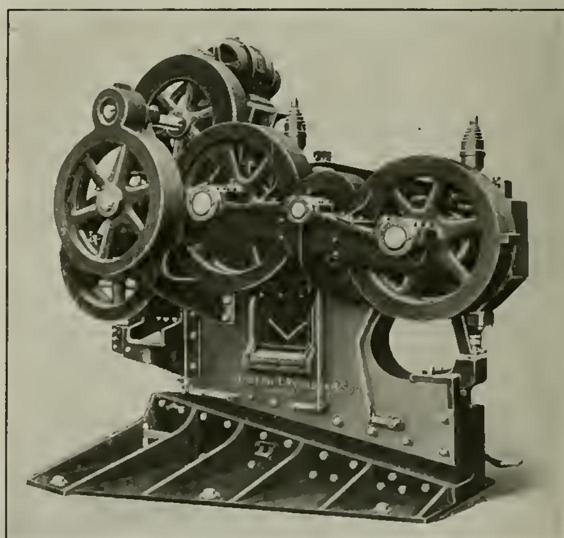


Fig. 3—Back View Showing Arrangement of Overhanging Machine Parts.

The main frame of the machine consists of a skeleton offset shear body, which is reinforced by heavy steel plates, making the machine extremely rigid and able to withstand severe stresses. The skeleton frame and plates are properly interlocked by means of machine steel pins. The universal plate shear permits of splitting plates up to the maximum capacity in any length and width. An adjustable hold-down for the material is provided.

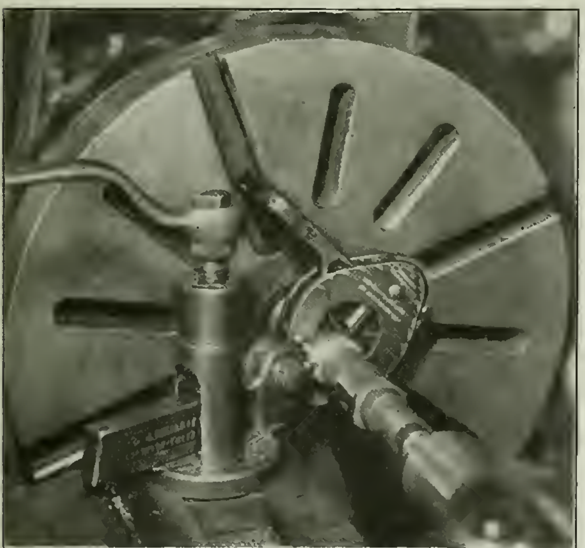
All clutches are equipped with standard architectural jaws, which permit the punching of standard I-beams, channels and sections, both in the flange and the web. Here again adjustable hold-downs are provided, and a cam shaft and hand-wheel arrangement permits the centering of the punch to the full length of the stroke. A shear for cutting round and square bars is provided in the sliding head of the plate shear. Depending upon the capacity of the machine, blades with three or four notches can be provided.

The original design of this quintuple punching and shearing machine provides for direct motor drive, but if desired a belt drive with tight and loose pulley belt shifter can be furnished.

CAM TYPE LATHE DOG

There is more or less danger connected with the use of the common type of lathe dog with its projecting set screw. To obviate this difficulty the Efficiency Device Corporation, Long Island City, N. Y., has devised the lathe dog shown in the illustration, which depends for its action upon the cam principle. It is also claimed that a considerable saving in time is realized, due to the fact that no time is wasted in hunting for wrenches to tighten or loosen the set screw used in the lathe dog of the ordinary type.

A swing of the smooth-jawed cam will open the dog to any size within its capacity and, after the work is inserted, springs actuate the cam and close it automatically. The lathe dogs do not depend upon the springs, however, for their driving power, because the harder the pull the tighter the grip. Due to the absence of teeth on the cam, the work is not scored or marked.



Cam Type Lathe Dog in Operation.

This lathe dog is made of a steel drop forging, heavily case-hardened. There are five dogs in a set, with a capacity ranging from ½ in. to 3 in. in diameter, each size having an automatic adjustment of ½ in.

A RADICAL DEPARTURE IN FREIGHT CAR DOOR FIXTURES

One of the trying problems which railway employees have to face is that of opening freight car doors without damage to the doors. A new device which is intended to remove this difficulty is the Jerry Loc-Lever. The Loc-Lever works on the leverage principle and when applied takes the place of locks, hasps and starters. The iron bar which forms the lever proper is suspended from the side plate of the car by a bolt and reaches a point a few inches below the lower edge of the car door. Another bar is fastened to the car door and extends across it horizontally about one-third the way from the top. To this are attached four fulcrum pinions formed of bolts inserted through steel tubes, large enough in diameter to revolve around the bolt and thus form a roller bearing. The handle of the main lever is so constructed that the seal or the lock of the car can be inserted through convenient orifices. In operation, when the door is closed the Loc-Lever bar lies against the last pinion and holds the door securely in place. When the door is to be opened the seal is broken, thus releasing the lever, which is then raised away from the car a distance sufficient to pass it over the last pinion, against which it then lies in a diagonal position. A pull is exerted on the handle and from the resulting leverage the door is forced open a short distance. The operation is repeated on the three other pinions in turn, with the result the door is fully opened without damage.

A Combined Door Lock and Opener

The device takes its name from the nickname of its inventor, H. F. Jerolaman, of the traffic department of the Atchison, Topeka & Santa Fe, who is familiarly known as "Jerry." In his work Mr. Jerolaman noted the difficulties encountered in connection with the opening of car doors and this device is his idea for overcoming the trouble. Besides effecting a considerable saving in the damage ordinarily done the car door, it is anticipated that the device will also save time at stops and transfer points.

INTERCHANGEABLE UNIT SCREW MACHINES

A new line of hand-screw machines, embracing five sizes, to handle work from 7/16 in. to 2-9/16 in., has been designed recently by the Foster Machine Company of Elkhart, Ind. The unit principle of design has been carried out and, as applied to this line of machines, each machine is assembled from a number of separate units built and kept in stock as independent units. For instance, three different styles of cut-off units are available, the lever feed cut-off, hand screw feed cut-off and power feed cut-off. These are interchangeable, one with the other, and can be furnsihed as required. The power feed of the turret is a separate unit, and a machine can therefore be built either with power feed for the turret slide or with hand feed. The automatic chuck and bar feed are independent units and can be furnished or omitted as required.

The No. O and No. 1 screw machines, which are of 7/16-in. and 15/16-in. bar capacity, respectively, are designed for high spindle speeds and the sensitiveness of operation essential in machines of small bar capacity.

The No. 3 screw machine, the bar capacity of which is 1 5/16 in., is built in both the plain head and friction head types. The No. 5 and the No. 7 screw machines, with a bar capacity of 1-13/16 in. and 2-9/16 in., respectively, are built in the friction head type only. The large diameter cone pulley and the powerful friction provide ample power for heavy requirements. The turret slide has an effective travel of 7 in. for the No. 3, 9 in. for the No. 5 and 11 in. for the No. 7 screw machine.

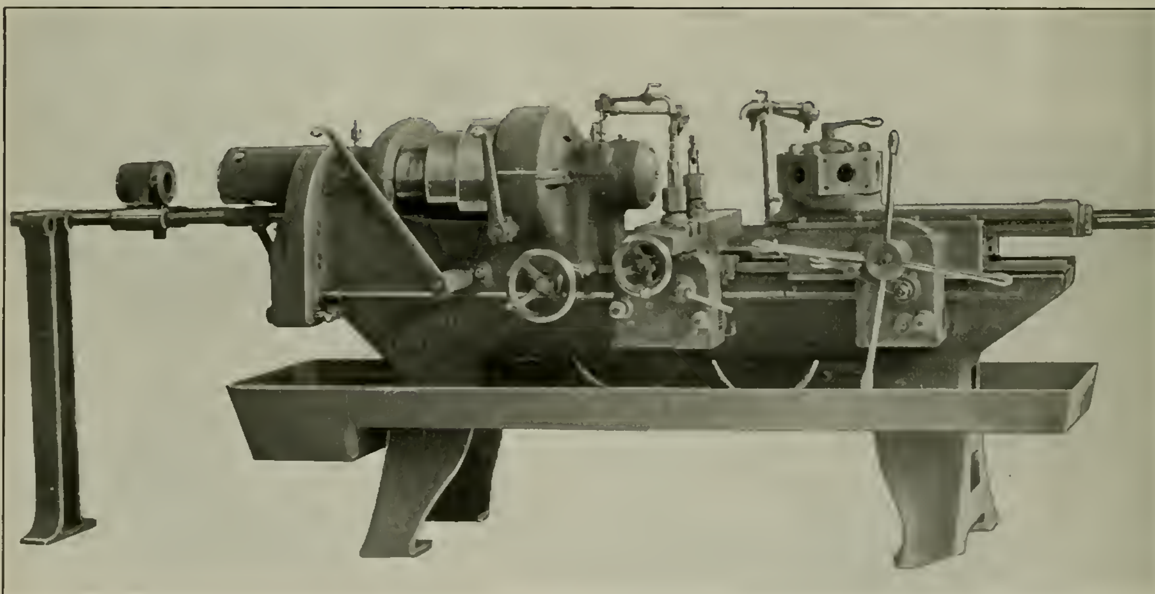


Fig. 1—No. 7 Foster Hand Screw Machine.

The gear friction head, as shown in Fig. 2, has a powerful friction clutch, mounted on the spindle between the cone pulley and the friction gear, which serves to engage the spindle into driving connection direct with the cone pulley on one side or with the back gears through the large diameter spindle gear on the other side. The frictions are of the cone type and are operated by the hand lever through the

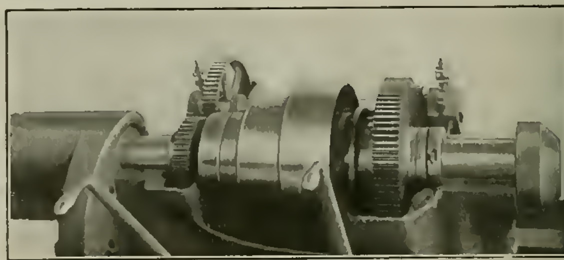


Fig. 2—Arrangement of Friction Head.

medium of a long, movable sleeve and four fingers mounted on the spindle. They are powerful but sensitive in operation.

The automatic chuck is of a standard spring collet type, and the operating machanism differs materially from previous designs. The fork lever principle has been utilized instead of the sliding fork principle, which eliminates the cocking action and reduces friction. The automatic chuck fingers are equipped with rollers to eliminate friction at this point. It is claimed that with this type of chucks 40 per cent of the force usually applied at the handle of the operating lever will hold the stock.

The bar feed operating mechanism also is new, in that the continuous motion of the automatic chuck lever as it opens the collet feeds the bar forward. This is accomplished through a system of links and levers in such a manner that the automatic chuck and the bar feed are operated intermittently.

On the heavier screw machines a hexagon turret is used with an indexing mechanism, which is very sensitive in operation. The vertical lock bolt is mounted underneath the front side of the turret, directly beneath the working tool. The end of the lock bolt lever, which intermittently engages the tumbler for withdrawing the lock bolt preliminary to the indexing of the turret, is equipped with a roller for the sake of sensitiveness and reduction of wear.

A system of revolving independent stops are gibbed to the turret and index with it. The power feed apron for the turret slide is shown in Fig. 3. The three sliding gears, together with a cluster of two sliding gears in the gear box at the end of the machine, provide six different speed changes. The

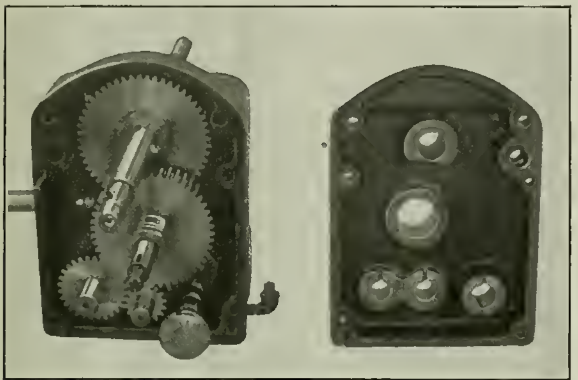


Fig. 3—Power Feed Apron for Turret Slide.

power feed is engaged and disengaged by a friction working in conjunction with the gear engaging the large driving gear of the pinion shaft. The apron is oil-tight, and the lower gears in the gear train, including the worm gear, run in a bath of oil.

The arrangement of gears in the cross feed apron is similar to that in the turret slide, except for the introduction of sliding gears to obtain a reverse of the feed movement. The feed friction, which works in conjunction with the two large intermediate gears, is operated by a ratchet acting as a powerful cam, manipulated by a hand lever. The three-step sliding

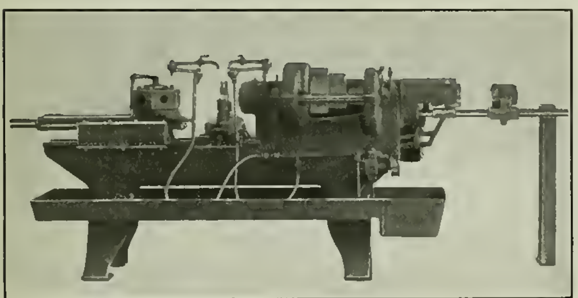


Fig. 4—Rear View Showing Double System of Piping.

gear nests in the apron in conjunction with the two changes obtainable in the gear box at the head of the machine, as described, provide six changes of speed to the cross slide.

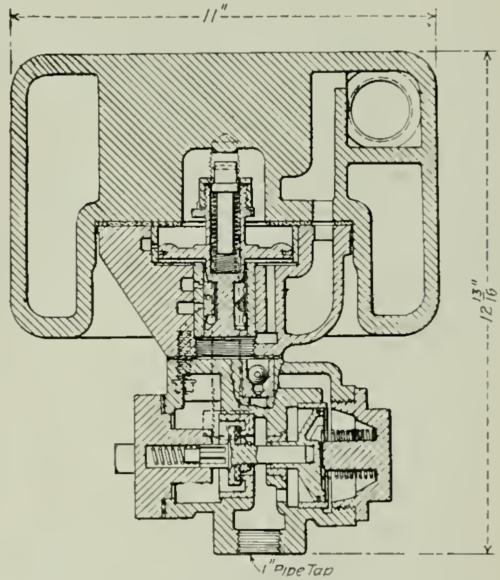
The location of the hand longitudinal feed screw between the ways of the bed is an important feature of this machine. The force moving the cut-off carriage on the bed is applied in the middle of the guards instead of on the front side, where a slight cocking action may result in inaccuracy of adjustment and undue wear of the machine at this point. Large diameter graduated dials, equipped with observation stops, are provided for both the hand longitudinal feed and also for the cross feed.

A double system of piping is provided, as shown in Fig. 4, together with a suitable rotary pump, to furnish the proper amount of coolant to the worm and cutting tools. One system works in conjunction with the turret slide and the other with the cut-off. On the smaller machines, where a smaller amount of coolant is required, only a single system of piping is used.

NO. 4 BRAKE PIPE VENT VALVE

The Westinghouse Air Brake Company, Wilmerding, Pa., has recently developed a brake pipe vent valve to provide a more positive means than has heretofore been available for initiating and propagating quick action throughout a train. Changes in service conditions involving the handling of trains of greater weight and length, with increased brake pipe volume, have made it increasingly difficult to insure the proper quick action throughout the train. This is especially true when double heading, or when the first car or cars in a train are cut out, or when the cars are so coupled together (in cases where the triple valves are installed on the ends) that they are too far apart for quick action to be carried from one to another and throughout the train.

The No. 4 brake pipe vent valve has been designed to

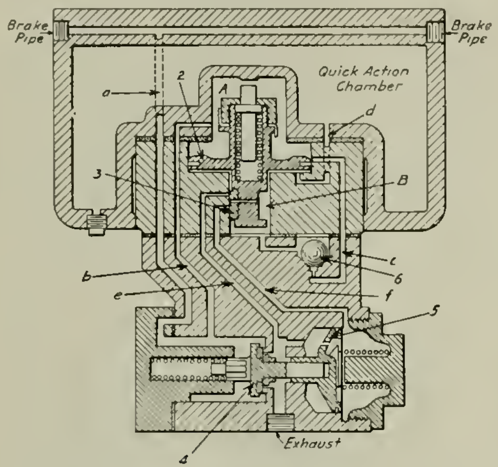


Cross Section of Vent Valve

meet these conditions and, to insure the necessary stability of operation, has been made a separate device to operate independently of the triple valve, distributing valve or other venting devices. Thus the reliability of the vent valve is uniformly insured, at the same time undesired quick action due to erratic action of the service parts of other brake devices or to the overcharging of the brake pipe on the engine and tender is eliminated.

The No. 4 brake pipe vent valve comprises an emergency piston, *2* (Figs. 1 and 2), with its slide valve, *3*, a vent valve *4*, and quick action piston, *5*, and an actuating volume called the quick action chamber. When the system is being charged, brake pipe air flows through passage *a* to the left of vent valve *4*, and thence through passage *b* to chamber *A* above the emergency piston *2*, forcing the piston to its lowest position. This opens charging port *c* in the piston bushing, permitting brake pipe air to flow past ball check valve *6* to the slide valve chamber *B* and thence through passage *d* to the quick action chamber, charging the latter to brake pipe pressure.

When a service reduction is made in brake pipe pressure, the emergency piston moves upward until stopped by its graduating stem. The charging port is now closed by the piston and the slide valve chamber is connected through the slide valve to the exhaust passage *e*. This permits quick action chamber pressure to reduce in pressure at the same rate as the brake pipe pressure, thus preventing operation of the vent valve during service applications. (When the brakes are released, the quick action chamber is again



Diagrammatic View of the Brake Pipe Vent Valve

charged as above described with the increasing brake pipe pressure.)

When an emergency rate of brake pipe reduction is made, the sudden drop in pressure causes the emergency piston *2* to move upward to its limit of travel, that is, against the cap gasket, opening port *f*. Quick action chamber air in chamber *B* then flows through port *f* to the outer face of quick action piston *5*, and since there is no pressure on the other face of this piston at this time it is moved to the left, opening the vent valve *4*. This makes a direct opening from the brake pipe to the atmosphere through large ports and consequently accomplishes the rapid venting of brake pipe air so necessary for propagating quick action on adjacent vehicles.

A small vent port through the quick action piston allows quick action chamber air to bleed down until the spring operating against vent valve *4* can force both the valves and piston to their normal position, thus closing the outlet to the atmosphere and permitting the brake pipe (and quick action chamber) to be recharged when desired, as above described.

KEROSENE BURNING FURNACE

A high-sustained temperature, generated in a short period of time, with strict economy of operation, are features of the furnace illustrated, which is manufactured by the Champion Kerosene-Burner Company, Kenton, Ohio. This heating unit is self-contained and may be used in heating rivets, hardening tools and similar operations.

In operation a quick, intense flame is obtained, as the kerosene is reduced to a gas the moment before being ignited. The effect is the same as that secured by the vaporizing jet in the carburetor of an internal combustion engine. It is claimed that all of the fuel units of the kerosene are utilized and no waste remains to form smoke or unpleasant odors. The flame gives a range of heat of from 2,500 to 3,000 deg. F.

The self-contained feature of the furnace gives it a distinct advantage. The fuel storage tank, carried on the lower platform of the stand, is of sufficient capacity to operate the furnace, with the feed valve wide open, for a 10-hour day. For this reason no electric or pipe connections need be installed in the shop or field. The furnace can be lifted by a crane and moved from place to place without extinguishing the flames. This insures a considerable saving in time both of the operator in changing connections and in cooling and reheating the furnace again.

Compressed air, at a pressure of from 80 to 90 lb., draws the fuel from the storage tank to the burner. This air is forced into the tank by means of an ordinary automobile pump, a pressure gage on the top of the tank showing the air pressure at all times. In spite of the fact that fuel is constantly being drawn out of the tank, with a consequent lowering of the fluid level and enlargement of the air space, the original air pressure still remains adequate to properly feed the burner, and only in exceptional cases does the air supply have to be given extra attention after it has once been taken care of in the morning.

The furnace is economical in the use of fuel. It is claimed that the kerosene consumption, with the furnace operating

Champion Kerosene Burner Furnace.

at its utmost capacity, does not exceed three-quarters of a gallon an hour. In a 10-hour shift the consumption is seven and one-half gallons. At a wholesale price of 14 cents a gallon, the daily cost of fuel would amount to $1.05. The non-oxidizing character of the flame permits leaving the work in the furnace for a long period without danger of burning it or diminishing its size.

If necessary a whole keg of rivets can be dumped into the hearth of this furnace and preheated. Rivets rfo immediate use can be placed directly under the flame of the burner, while the others, already in a semi-heated condition, can be raked in as needed. The Champion Kerosene-Burner furnaces are made in various sizes and provided with one or more burners, depending upon the type of work for which they are intended.

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue 12,200 copies were printed; that of these 12,200 copies, 11,124 were mailed to regular paid subscribers, 20 were provided for counter and news company sales, 229 were mailed to advertisers, 29 were mailed to employees and correspondents, and 798 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 119,910, an average of 9,992 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

George Bradshaw, supervisor of safety of the Grand Trunk Western lines and the Pere Marquette, says that the Grand Trunk Western had the fewest casualties per 100 employees during the period of the recent "No accident drive" of any railroad in the United States having the same or a greater number of employees.

Press despatches from Paris, dated November 27, say that on the day preceding the first locomotive on a French railroad to use oil as fuel was sent out on an experimental trip and hauled a heavy train with complete success. It is announced that railroads in France have planned to alter their engines to use oil fuel instead of coal and that 200 locomotives may be thus changed.

Several important Bohemian banks have formed a ten million crown company for the renting of freight cars under the name of Tschechoslovakische Wagonleih-A. G. Negotiations will be taken up with foreign car manufacturers. The cars will be purchased outright and rented only to such industrial undertakings as are stockholders and in proportion to the amount of stock they hold.

Commercial Attache J. E. Philippi, Rio de Janeiro, reports that a commission has been appointed to make a special study looking to the adoption of uniform types of equipment and material for the government railways of Brazil. The members of the commission are to be engineers from the Federal Department of Railway Inspection and the federal railways. The first study will be devoted to the selection of uniform types of locomotives, passenger cars and freight cars for the railroads of one meter gage.

Arrangements for the use of oil as locomotive fuel on the lines of the Missouri, Kansas & Texas in Texas and on some of its Oklahoma lines have been practically concluded and engines are being changed. On the Wichita Falls & Northwestern the work will be completed by January 1. Next, the engines in service in the Smithville district of the Missouri, Kansas & Texas of Texas will be changed, and by the end of the summer of 1920 it is expected that all of the engines on the Texas lines will be equipped to use oil instead of coal. Because of the large expenditure required to equip the locomotives it was necessary to make a long-time contract for fuel in order to protect the additional investment.

The materials clearing house organization of the Pennsylvania Railroad has been transferred from Altoona, Pa., to Philadelphia, in order that the work may be concentrated as far as possible under the supervision of G. W. Snyder, 2d, recently appointed general storekeeper. A number of the clerks were transferred to the Philadelphia office, while a few were retained at Altoona under the jurisdiction of W. F. Vogt, district storekeeper. The remainder have been furloughed until positions can be found for them in other departments.

In order to standardize both equipment and operating practices, the Board of Railway Commissioners for Canada recently ordered that all passenger cars and cabooses hereafter constructed shall be equipped with marker sockets fixed at such elevation as will permit lamps and flags to be placed therein from the platform or floor of the car without the use of steps. Furthermore, according to the order, all passenger cars and cabooses now in use and not equipped with marker sockets in this position must be so equipped on or before May 1, 1920. The action was taken because of the placing of marker sockets at the corners of the roofs in addition to the lower position on some of the passenger cars of the Grand Trunk.

Fuel conservation measures on the Chicago Great Western resulted in such substantial savings during the early months of 1919 that W. L. Park, federal manager, has addressed a letter of commendation to all enginemen as well as others who contributed less directly in securing such a satisfactory record. A comparison of the fuel performance for January, February and March, 1919, with the same months of the previous year, showed a decrease in coal per 1,000 gross ton-miles in freight service equal to 10.7 lb., or 4.1 per cent., equivalent to a monetary saving of $13,956. In passenger service, based on pounds of coal per passenger train car-mile, there was a decrease of 3.1 lb. or 12.9 per cent, amounting in money to $23,650, or a total saving in freight and passenger service of $37,606 for the three months.

J. H. Thomas, the general secretary of the National Union of Railwaymen, who has been conducting negotiations with the British Government relating to railwaymen's wages, in a speech before railwaymen at Bristol on November 16, outlined the government's offer to the railwaymen regarding their participation in government control of the railways. In brief, the plan is that three union representatives will join the Railway Executive Committee with powers equal to those of the general managers on this committe; a joint board is to be formed composed of five general managers and five representatives of the unions to deal with conditions of service; a committee of 12 is to be formed composed of four representatives from the unions, four from the railway companies and four from the public, with an independent chairman, which will consider questions on which the joint board fails to agree, and, further, local committees will be formed made up of an equal number of representatives from the management and the men to deal with local grievances.

Railroad Reserve Force Proposed

A bill introduced by Senator Thomas of Colorado just before the Senate adjourned on November 19 provides for the creation of a railroad army reserve force of 200,000 men to be trained at land grant agricultural colleges for service on the railroads in times of emergency. Men between 18 and 30 years of age will be eligible for enlistment, but not for re-enlistment. The term of enlistment would be for 10 years, with a provision for 12 months' training for work as train operatives, hostlers or telegraph operators, and during the training period the men would receive regular army pay. If in time of emergency they were put to work on railroads they would receive the usual railroad pay, but would be barred from having any connection with a labor union.

Electrification in Foreign Countries

Electrification of railway lines is constantly receiving more attention and reports indicate that it is being given serious consideration in Sweden, France, Belgium, England, Italy, Switzerland, Australia, Brazil, Chile and Jamaica. In most of these countries electrification is particularly desirable on account of the increased cost of coal and because of the fact that there are in certain sections large water supplies which can very easily be used for the operation of hydro-electric plants.

A committee of French railway engineers has given the electrification situation in America a careful study. A special committee appointed to draw up a program for the electrification of the principal railroads has been able to gather together much valuable data concerning the use of hydro-electricity. Its program proposes the electrification of 5,220 miles of lines of three of the principal railroads, the Paris-Orleans, the Paris, Lyons & Mediterranean and the Midi. In determining upon lines to be electrified, the Midi and the Paris-Orleans considered the relation of the cost of electric power as compared with the cost of power with steam locomotives, and the comparison showed that mountain lines with sufficient traffic should be among the first to be electrified. They also considered the location of the source of hydro-electric energy in relation to the lines, and the importance of this power to other industries. On the Paris, Lyons & Mediterranean, however, the possibility has been considered of using electricity on lines of low grade where there is a heavy traffic, even before putting it on mountain lines where the traffic of these lines is very small. The probable cost, based on prices before the war, is estimated to be $335,000,000. With the traffic of 1913, electrification would save 1,500,000 metric tons of coal, and in the near future the economy should not be less than 3,000,000 metric tons.

Electrification of Belgian railways has been decreed by the Minister of Railways, following a favorable report on such a project made by a committee appointed to investigate such a course. The first line to be electrified will be that from Brussels to Luxemburg, and later the Brussels-Ostend Railway. It is planned to begin the reconstruction work early in 1920.

In Jamaica the government is reported as arranging to have a survey made of the water power of the large rivers to see if electrification of the railways is feasible. The heavy cost of coal and the necessity of a considerable railroad extension owing to an expected agricultural development explain the proposed change. The local agent of the Westinghouse Company, of New York, is collecting data on which the Westinghouse Company might tender plans for laying down the electric railroads.

In Brazil plans have been made for the electrification of the suburban lines of the road and the trunk line from Barra to Pirahy, as well as general plans for the suburban service and the closing of the roadbed from the main station to Deodoro, writes Commercial Attache J. E. Philippi, Rio de Janeiro. The approximate cost of the rolling stock, substations, aerial lines, etc., is estimated at $4,307,377. This does not include the cost of car sheds at the main station and at Deodoro.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.
American Railroad Association, Section III.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.
American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.
American Railway Tool Foremen's Association.—R. D. Fletcher, Belt Railway, Chicago.
American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.
American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.
Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.
Car Foremen's Association of Chicago.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.
Car Foremen's Association of St. Louis.—Thomas B. Koeneke, secretary, Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.
Chief Interchange Car Inspectors' and Car Foremen's Association.—H. J. Smith, D. L. & W., Scranton, Pa.
International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio.
International Railway Fuel Association.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.
International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.
Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention May 25-28, Curtis Hotel, Minneapolis, Minn.
Master Car and Locomotive Painters' Association of U. S. and Canada. A. P. Dane, B. & M., Reading, Mass.
Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.
Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.
Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Dec. 9, 1919	The House That Jack Built (Moving Picture); first aid demonstration by E. E. Stevens		W. A. Booth	131 Charron Street, Montreal, Que.
Central	Jan. 9, 1920			H. D. Vought	95 Liberty Street, New York.
Cincinnati				H. Boutet	101 Carew Building, Cincinnati, O.
New England	Dec. 9, 1919	Operation of Railroad Terminals, New York Terminal District	I. J. Mantell	W. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Dec. 19, 1919	The Industrial Conflict	William L. Chenery	H. D. Vought	95 Liberty Street, New York.
Pittsburgh	Dec. 26, 1919			J. D. Conway	515 Grandview Avenue, Pittsburgh, Pa.
St. Louis	Dec. 19, 1919	The Cummins Bill	Ex-Senator N. P. Wilfrey	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Dec. 15, 1919	Increasing Necessity for Steam Railway Electrification	N. W. Storer	J. M. Byrne	916 West 78th Street, Chicago.

PERSONAL MENTION

GENERAL

J. V. B. DUER, assistant engineer of the Pennsylvania at Altoona, has been made electrical engineer of the new electrical engineering department operated in conjunction with the mechanical engineering department at Altoona.

HENRY GARDNER, supervisor material conservation of the Baltimore & Ohio, with headquarters at Baltimore, Md., has been appointed corporate mechanical engineer, succeeding Morgan K. Barnum, whose death was noted in the November issue. Mr. Gardner was born in Salem, Mass., in 1872 and graduated from the Massachusetts Institute of Technology in 1896. Immediately after graduation he began railroad work as a special apprentice in the Boston & Maine shops at Boston, Mass., at which work he remained until 1900, when he was appointed shop draftsman and inspector at Concord, N. H. During 1904 and part of 1905 he was assistant master mechanic at Concord; between 1905 and 1911 he was respectively erecting shop foreman for the American Locomotive Company at Allegheny, Pa., locomotive designer for the H. K. Porter Company, Pittsburgh, Pa., assistant superintendent of apprentices of the New York Central at New York City; and from 1911 to 1914 was superintendent of apprentices and shop systems. In 1914 he went to the Baltimore & Ohio as assistant superintendent of shops at Baltimore, and the following year was appointed special engineer in the office of the vice-president, also at Baltimore, an office he held until 1917, when he was chosen for the position of supervisor of material conservation, which he filled until the time of his recent appointment, of which mention is made above.

H. Gardner

A. B. CORBETT, whose appointment as assistant mechanical superintendent of the Missouri, Kansas & Texas, with headquarters at Denison, Tex., was announced in the November issue, was born in 1874 at Hannibal, Mo., and received his education in the public schools of Denison, Tex. His entire railroad service has been with the Missouri, Kansas & Texas, he having entered the employ of this road in June, 1888, as a machinist apprentice. After completing his apprenticeship he worked as a machinist until February 1, 1908, when he was appointed night roundhouse foreman at Denison, later being made day roundhouse foreman. On December 1, 1915, he was transferred to Smithville, Tex., as general foreman. On March 1, 1916, he was appointed shop superintendent at Denison and on April 1, 1917, was transferred to Parsons, Kans., in the same capacity, remaining there until September 15, 1919, when he received his appointment as assistant mechanical superintendent.

G. H. HASELTON, general locomotive inspector of the New York Central Lines East, with office in New York, has been retired after 53 years of service in the motive power department, having been general locomotive inspector for the past 12 years.

C. H. HOLDREDGE, road foreman of engines of the Southern Pacific, with headquarters at San Francisco, Cal., has been appointed assistant general air brake inspector succeeding A. M. Meston, promoted.

HARRY A. HOKE, acting assistant mechanical engineer of the Pennsylvania at Altoona, Pa., has been appointed assistant mechanical engineer, succeeding W. F. Kiesel, Jr. Mr. Hoke was born on October 13, 1873, at Union City, Ind. He was graduated from Purdue University in 1896, and on March 1, 1898, entered the employ of the Lake Shore & Michigan Southern as a draftsman at Cleveland. Since December, 1898, however, he has been with the Pennsylvania Railroad at Altoona, being promoted to the position of assistant chief draftsman on September 1, 1902, and to assistant engineer of the mechanical engineering department on June 1, 1906. On February 1, 1919, he was appointed acting assistant mechanical engineer, and on October 20, 1919, was made assistant mechanical engineer.

J. S. JENNINGS, division master mechanic on the Michigan Central at Bay City, Mich., has been promoted to assistant superintendent of motive power, with headquarters at Detroit, Mich., a newly created position.

W. F. KIESEL, JR., who was appointed acting mechanical engineer of the Pennsylvania at Altoona, Pa., on the retirement of A. S. Vogt, has been appointed mechanical enginner. A photograph and sketch of Mr. Kiesel's career were published in the March, 1919, issue, page 165.

B. J. PEASLEY, master mechanic of the Vicksburg, Shreveport & Pacific, has been appointed superintendent of motive power of that road and of the Alabama & Vicksburg and the Louisiana & Mississippi Transfer, at Monroe, La. Mr. Peasley was born on December 21, 1867, at Decorra, Ill., and entered railway service at the age of 16 as a laborer and machinist apprentice with the Chicago, Burlington & Quincy, at West Burlington, Iowa. After serving his apprenticeship he entered a business college at Burlington, Iowa, and on completion of the course again entered railway service as a machinist with the Atchison, Topeka & Santa Fe, at Ft. Madison, Iowa. From 1894 to 1901 he was employed respectively by the Ft. Madison Gas & Gasoline Engine Company, by the Chicago, Ft. Madison & Des Moines, as fireman and engineman, and by the Illinois Central at East St. Louis, Ill., as a machinist and later division and wrecking foreman at Carbondale, Ill. In 1901 he entered the service of the Denver & Rio Grande as roundhouse foreman at Helper, Utah, where he remained a short time, returning to the Illinois Central at East St. Louis, Ill., acting successively as roundhouse foreman, shop foreman and general foreman until September, 1906. At that time he was appointed general foreman of the Missouri Pacific at Bixby, Ill., later being promoted to master mechanic at Ferriday, La., where he remained for six months, being then transferred to De Soto, Mo., as master mechanic of the Missouri division. From February, 1914, to the early part

B. J. Peasley

of 1918 he was superintendent of shops at Argenta, Ark., when he was appointed mechanical superintendent of the St. Louis-Southwestern of Texas, with office at Tyler, Tex. During the early part of the present year he accepted the position of master mechanic of the Vicksburg, Shreveport & Pacific, which he held until his recent promotion.

F. A. McArthur has been appointed mechanical valuation engineer in charge of the valuation of rolling stock of the St. Louis-San Francisco.

Major C. E. Lester has been discharged from military service and appointed assistant supervisor of equipment with the Railroad Administration at Meadville, Pa.

D. M. Pearsall, shop superintendent of the Atlantic Coast Line at Waycross, Ga., has been appointed superintendent of motive power, second and third divisions, with the same headquarters.

S. A. Schickedanz, chief draftsman of the Chicago & Eastern Illinois at Chicago, has been promoted to mechanical engineer at Danville, Ill., succeeding W. H. Hauser, who has resigned to become connected with the A. B. C. Transit Refrigeration Company, Chicago.

R. Tawse, master mechanic of the Detroit, Toledo & Ironton, at Jackson, Ohio, has been promoted to superintendent of motive power and equipment, with the same headquarters.

E. W. Smith, superintendent motive power of the Pennsylvania Railroad, Central division, at Williamsport, Pa., has been transferred to Altoona, Pa., as acting superintendent motive power, relieving R. K. Reading, granted leave of absence because of illness.

S. M. Viele has been appointed assistant electrical engineer of the new electrical engineering department of the Pennsylvania at Altoona.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

William H. Menner, road foreman of engines of the Erie, with headquarters at Jersey City, N. J., has been appointed supervisor of locomotive operation, succeeding E. Salley, deceased.

G. T. Bourne, traveling engineer and trainmaster of the Salt Lake division of the Denver & Rio Grande, with headquarters at Soldier Summit, Utah, has been transferred to the Green River division, with the same headquarters.

Lon Byers, terminal engine inspector on the Atchison, Topeka & Santa Fe Coast Lines at Needles, Cal., has been promoted to road foreman of engines of the first district of the Arizona division, with the same headquarters, succeeding L. H. Ledger.

A. L. Crew, road foreman on the Atchison, Topeka & Santa Fe Coast Lines, with headquarters at Los Angeles, Cal., has been promoted to general road foreman of engines, with the same headquarters, a newly created position.

Andrew J. Devlin, supervisor of shops of the St. Louis-San Francisco, has been appointed master mechanic of the Western division, with headquarters at Enid, Okla. Mr. Devlin was born on June 20, 1868, at Philadelphia, Pa., and was educated in the public schools and Quaker private school. His railroad service dates from August 1, 1904, when he entered the employ of the Atchison, Topeka & Santa Fe as assistant machine foreman. On June 8, 1906, he became shop demonstrator, and on March 1, 1910, supervisor of efficiency work. Since March, 1914, he has been with the St. Louis-San Francisco, first as traveling roundhouse foreman, later as inspector of shop efficiency and then as supervisor of shops, which latter position he held at the time he was appointed master mechanic of the Western division.

Guy F. Egbers has resigned from service with the Russian Railway Service Corps and returned to the Northern Pacific as master mechanic, Pasco division, at Pasco, Wash.

L. H. Ledger, road foreman of engines of the first district, Arizona division, of the Atchison, Topeka & Santa Fe Coast Lines, at Needles, Cal., has been transferred to the second district, with the same headquarters, succeeding C. C. Reynolds.

G. M. Lillis, locomotive engineman of the Denver & Rio Grande, has been appointed traveling engineer and trainmaster of the Salt Lake division, with headquarters at Soldier Summit, Utah, succeeding G. T. Bourne.

William D. Johnston, whose appointment as general master mechanic of the Northwest territory of the Baltimore & Ohio Western Lines, with office at Cleveland, Ohio, was announced in the November issue, was born in Ohio on November 12, 1869. After graduating from the Nickerson (Kansas) high school he took employment as a machinist apprentice with the Atchison, Topeka & Santa Fe. Later he was roundhouse foreman of the Cotton Belt at Pine Bluff, Ark., then general foreman of the Trinity & Brazos Valley at Teague, Texas. Afterwards for different periods of time he was with the Oregon Short Line as general roundhouse foreman at Pocatello, Idaho, general foreman of the Chicago, Rock Island & Pacific, and master mechanic of the International and Great Northern at Palestine, Texas. On May 15, 1914, he entered the service of the Baltimore & Ohio as master mechanic of the Toledo division, was transferred to the Newark division on December 1, 1917, and was appointed general master mechanic of the Northwest territory on August 1, 1919.

W. D. Johnston

J. C. Love, road foreman of engines of the first and second districts of the Los Angeles division of the Atchison, Topeka & Santa Fe Coast Lines, with headquarters at San Bernardino, Cal., has been transferred to the third and fourth districts, with headquarters at Los Angeles, Cal.

F. P. Miller, master mechanic on the Chicago, Milwaukee & St. Paul, with headquarters at Marion, Iowa, has been transferred to Portage, Wis., succeeding M. F. Smith.

C. C. Reynolds, road foreman on the Atchison, Topeka & Santa Fe Coast Lines, at Needles, Cal., has been transferred to the first and second districts of the Los Angeles division, with headquarters at San Bernardino, Cal., succeeding J. C. Love.

M. F. Smith, master mechanic on the Chicago, Milwaukee & St. Paul, with headquarters at Portage, Wis., has been transferred to Minneapolis, Minn.

C. E. Trotter has been appointed master mechanic of the Lake Erie & Western, the Fort Wayne, Cincinnati & Louisville and the Northern Ohio, at Lima, Ohio.

Christian A. Worth, acting master mechanic on the Pasco division of the Northern Pacific, has resumed his former position as road foreman of engines of the Pasco division.

CAR DEPARTMENT

H. G. Griffin, manager of the National Bridge Company, Montreal, Quebec, has resigned to become general superintendent of the car department of Morris & Co., Chicago.

Samuel Lenzner, master car builder of the Michigan Central with headquarters at Detroit, Mich., has been appointed supervisor of passenger equipment, a newly created position. Mr. Lenzner was born June 30, 1861, at Lancaster, N. Y., and has been with the Michigan Central since July 12, 1886, when he began railway work as a coach carpenter. In September, 1889, he was made foreman of the cabinet department, and in March, 1909, was advanced to general foreman of the car department, which position he held until early in 1913, when he was appointed master car builder.

C. J. Wymer, sales representative of the Grip Nut Company of Chicago, has been appointed superintendent of the car department of the Chicago & Eastern Illinois, with headquarters at Danville, Ill. Mr. Wymer entered railroad service in 1891 with the Atchison, Topeka & Santa Fe. He later became connected with the car inspecting department of the Chicago & Eastern Illinois, resigning as general car inspector in 1912. He was then appointed general car foreman on the Belt Railroad of Chicago. In May, 1916, he was appointed sales representative at the Chicago office of the Grip Nut Company, in which capacity he served until his recent appointment. Mr. Wymer's appointment places him in entire charge of the car department of the Chicago & Eastern Illinois and is the first appointment of this nature made by that road.

SHOP AND ENGINEHOUSE

T. J. Mullin, general foreman, shops of the Lake Erie & Western at Lima, Ohio, has been appointed shop superintendent of that road, as well as of the Fort Wayne, Cincinnati & Louisville and the Northern Ohio, with the same headquarters.

PURCHASING AND STOREKEEPING

Clifford C. Harrold, storekeeper on the West Virginia general division of the Chesapeake & Ohio, with offices at Huntington, W. Va., has resigned that position to become assistant manager for the Tri-State Credit and Adjustment Bureau, Huntington, W. Va.

F. E. Outerbridge has been appointed storekeeper of the Detroit & Toledo Shore Line, with headquarters at Lang, Ohio.

J. M. Strong has been appointed division storekeeper of the Schuylkill division, Pennsylvania Eastern Lines, with headquarters in Reading, Pa.

J. V. Bland, storekeeper of the Virginian at Sewalls Point, Va., has been appointed storekeeper at Roanoke, succeeding J. M. Mitchell.

F. H. Fechtig, purchasing agent of the Atlantic Coast Line at Wilmington, N. C., has been appointed purchasing agent of the Georgia and the Charleston & Western Carolina.

J. M. Mitchell, storekeeper of the Virginian at Roanoke, Va., has been transferred to Victoria, Va., succeeding K. A. Fernstrom, assigned to other duties.

W. N. Pollard, division storekeeper of the Southern & Columbia, S. C., has been transferred to South Richmond, Va., succeeding W. F. Lamb, deceased.

J. H. Smith has been appointed division storekeeper of the Southern at Columbia, S. C., succeeding W. N. Pollard.

SUPPLY TRADE NOTES

H. S. Waterman, sales manager for the Hutchins Car Roofing Company, Detroit, Mich., died in that city on December 1, after an illness of 10 days.

The Ralston Steel Car Company, Columbus, Ohio, has opened an office at 20 E. Jackson boulevard, Chicago, in charge of Ford S. Clark, formerly of the Philadelphia office of the company.

F. C. Wallace, of Pittsburgh, Pa., has withdrawn his resignation as president of the Canadian Locomotive Company, Kingston, Ont., and will continue in office. He has been granted a six months' leave of absence.

F. W. Sinram, general manager of the Van Dorn & Dutton Company, gear specialists, of Cleveland, Ohio, has been elected president of the company. Mr. Sinram is also president of the American Gear Manufacturers' Association.

The Sherwin-Williams Company, Cleveland, Ohio, is contemplating the erection of a factory at Kansas City, Mo., to cost $500,000. The first unit will be equipped for the manufacture of paint and will be followed by the construction of a varnish factory.

John Kopf, formerly associated with the Bureau of Air Craft Production, with headquarters at Dayton, Ohio, has been appointed manager of the engineering department of the Duff Manufacturing Company, Pittsburgh, Pa., with office in that city.

John B. Jordan, assistant manager of the railroad sales department of the Crane Company, with headquarters at Chicago, has been appointed manager of the department with the same headquarters, succeeding F. D. Finn, who has been granted an indefinite leave of absence.

John L. Bender has resigned as sales manager of the Anderson Forge & Machine Company, Detroit, Mich., to become connected with the engineering department of the C. A. S. Engineering Company, at Detroit, sales agent of the Pollak Steel Company, Cincinnati, Ohio.

Frank J. Walsh, mechanical expert with the Galena-Signal Oil Company, New York, has resigned to become secretary of the Douglas Wray Paper Company, Chicago. Previous to his service with the Galena-Signal Oil Company, Mr. Walsh was a division master mechanic on the Chesapeake & Ohio.

W. D. Horton, district sales manager of the Patton Paint Company, has resigned to accept a position in the western railway department of the Murphy Varnish Company, with headquarters at Chicago. Mr. Horton was circulation manager of the *Railway Mechanical Engineer* prior to his connection with the Patton Paint Company.

The International Railway Supply Company, New York, announces that it has incorporated the International Railway Supply Company of Cuba, with Otis R. Hale, former locomotive superintendent of the United Railways of Havana, as manager. The office of the company in Havana is at Edificio Abreu, Room 501, corner Mercaderes y O'Reilly.

A. C. Allshul, in charge of the Milwaukee, Wis., district office of Joseph T. Ryerson & Son, Chicago, has been appointed branch manager of the new warehouse plant at Buffalo, N. Y., this company having recently bought the warehouse plant, stock and good will of the Ferguson Steel & Iron Company, Buffalo. The property covered by the purchase includes a main building of about 100,000 sq. ft., a large crane-served yard, office building, garage and storehouse. Plans are being made to carry out extensive improvements to the property this coming winter. The Ryerson Company now has plants for warehouse service at Chicago, New York, Detroit, St. Louis and Buffalo.

G. O. Helmstaedter, Chicago district manager of the Hyatt Roller Bearing Company, has been promoted to sales manager of the industrial bearings division with office at New York, succeeding Carl E. Eby, who has been appointed to the board of directors of Hyatt, Ltd., London, a new company formed to market Hyatt bearings in Europe.

The A. Gilbert & Sons Brass Foundry Company, St. Louis, Mo., has recently completed a two-story with basement addition, 25 ft. by 180 ft., to its plant. The basement is to be used for the heating plant, wash rooms and lockers; the first floor for metal storage and melting rooms, and the second floor for the office and wood and metal pattern department.

Joseph T. Ryerson & Son Company, Chicago, has purchased a block of property adjoining its plant in that city, with an area of 380,290 sq. ft. A brick foundry building valued at $100,000, located on the property and at present occupied by the Crane Company, Chicago, will be used by the purchaser as the first unit of an addition to its facilities.

Work is now under way on the Niles, Ohio, plant of the Youngstown Steel Car Company, Hazelton, Ohio. The new plant will be used for repairing cars for railroad companies and private owners. Industrial cars of smaller dimensions than standard rolling stock will be built early in 1920. It is said the complete new plant will be in operation in January, 1920.

K. C. Gardner, assistant manager of sales of the Pressed Steel Car Company and the Western Steel Car & Foundry Company, has been appointed manager of sales for the central district with offices in the Farmers Bank Building, Pittsburgh, Pa. Mr. Gardner entered the employ of the Pressed Steel Car Company in 1901, and was connected with the operating department at McKees Rocks, Pa., until 1911. He was transferred to the New York office, remaining there for a period of eight years, and on January 1, 1919, returned to Pittsburgh as assistant manager of sales, central district, which position he held until his recent promotion to the position of manager of sales of the same district.

K. C. Gardner

C. F. Neudorfer, general plant superintendent for the Standard Tank Car Company, Masury, Ohio, has been promoted to general manager. N. L. Mabey, chief engineer, becomes assistant general manager. J. W. Todd, becomes assistant purchasing agent in the office of the superintendent of transportation, and J. T. O'Connor, superintendent of transportation, has been appointed purchasing agent.

The Keller Pneumatic Tool Company, Chicago, has opened branch offices in Birmingham, Ala., Jefferson County Bank building, under the management of H. I. Kahn; at Salt Lake City, Utah, in the Newhouse building, under the management of the C. H. Jones Company; and in San Francisco, Cal., Los Angeles, Cal., and Portland, Ore., all under the management of the Eccles & Smith Company, San Francisco.

Extensions are contemplated by the Lima Locomotive Works, Lima, Ohio, which will increase the plant's capacity approximately 50 per cent and involve an expenditure of $1,250,000. Additions to the present plant include a new erecting shop with a capacity of 70 locomotives a month, and a superheater shop extension for the boiler and tank works. New machinery costing approximately $300,000 will be purchased.

Huntley H. Gilbert, assistant manager of sales of the Pressed Steel Car Company and the Western Steel Car & Foundry Company, has been appointed manager of sales for the western district, at 425 Peoples Gas building, Chicago, Ill. Mr. Gilbert was graduated from Cornell University in June, 1907, with the degree of mechanical engineer. He then was in the employ of the Illinois Steel Company, the Scully Steel & Iron Company and the George E. Molleson Company, and in June, 1912, entered the employ of the Pressed Steel Car Company, as sales agent in the Chicago office. In 1915 he was sent to England and France as special representative to investigate the manufacture of shell forgings. In July, 1917, he was commissioned captain in the Ordnance Officers Reserve Corps and reported for duty July 25, 1917, as assistant to the chief of the Field Artillery Section, Carriage division, Ordnance Department, serving in Washington until February, 1918, when he was transferred to the Rock Island Arsenal as executive assistant to the commanding officer, later administrative officer, and on July 25, 1918, he was promoted to major. He attended the October, 1918, staff class at the War College, and was then appointed division ordnance officer, 97th Division, Camp Cody, N. M., serving there until the division was demobilized, at which time he was honorably discharged from military service. In January, 1919, he re-entered the service of the Pressed Steel Car Company and Western Steel Car & Foundry Company as assistant manager of sales, western district, and was recently promoted to manager of sales of the same.

H. H. Gilbert

H. H. Harris has been appointed manager of the heat treating equipment department of the Quigley Furnace Specialties Company, New York. Mr. Harris was formerly general sales manager for the Swedish Crucible Steel Company and has devoted several years to the practical application of materials for heat treating purposes, especially to steel mixtures and special alloys for carbonizing and annealing boxes, cyanide pots, etc.

A. G. Gibbons has become associated with the Wetmore Reamer Company, Milwaukee, Wis., as production engineer. He was formerly superintendent of tools and supplies for Winslow Brothers Company, Chicago. He also served with the Cadillac Company and the Brown & Sharpe Manufacturing Company for many years. The Wetmore plant has been rearranged and additional equipment installed under the direction of Mr. Gibbons.

The International Steel Tube Company has been incorporated under the laws of Delaware with a capital of $2,500,000, and is planning the immediate construction of the first unit of a seamless tube plant at Cleveland, Ohio. William P. Day, president of the International Steel Tie Company, is president, and Thomas Parrock, former superintendent of the Republic Steel Company, Youngstown, Ohio, is vice-president of the new concern.

Norton Company

Among the changes in personnel of the Norton Company, Worcester, Mass., following the reorganization of that company, were the appointments of Herbert Duckworth as sales manager of the grinding wheel division and of Howard W. Dunbar as sales manager of the grinding machine division. Mr. Duckworth is a native of Worcester county and attended the public schools in Worcester until 1895, when he accepted a position with the Norton Company, then known as the Norton Emery Wheel Company. In 1897 he was appointed head of the order department of that organization, in which capacity he served for about nine years. Subsequently he became a Norton representative in the outside field, covering successively New York state, Pennsylvania and New England. He was promoted to assistant sales manager in February, 1915. This position was held until the reorganization of the company, when Mr. Duckworth was appointed to the position which he now holds of sales manager of the grinding wheel division.


H. Duckworth

The appointment of Howard W. Dunbar as sales manager of the grinding machine division of the Norton Company brings to this position a man with comprehensive experience along general manufacturing and engineering lines. Mr. Dunbar's education in the general high school was supplemented by business and technical courses, and on leaving school he entered the employ of the Stanley Instrument Company, Great Barrington, Mass., as an apprentice on general work in the test division and drafting department. He later served an apprenticeship in tool-making for the same concern. After his experience with the Stanley Instrument Company Mr. Dunbar was employed by the New York Adding Typewriter Company as draftsman and tool designer. Later he was employed by the Ellis Adding Typewriter Company, J. M. Quimby Company, Newark, N. J., and for eight years by the Western Electric Company, New York, in the capacity of draftsman, designing engineer, assistant master mechanic and chief efficiency engineer. In March, 1915, Mr. Dunbar came to the Norton Grinding Company as assistant chief engineer, being engaged in development and engineering work under the direction of Charles H. Norton, designer of the Norton cylindrical grinding machines. Upon the merger of the Norton Grinding Company with the Norton Company Mr. Dunbar was appointed to his present position.


H. W. Dunbar

The T. H. Symington Company

At a meeting of the board of directors of this company, held in New York on October 22, C. J. Symington was elected president in charge of sales and operation, succeeding T. H. Symington, elected chairman of the board, both with headquarters at New York. Donald Symington, vice-president in charge of operation at Rochester, has resigned from the company.

Thomas H. Symington, chairman of the board, was born on May 14, 1869, at Baltimore, Md., and educated at Lehigh University. In 1885 he served as an apprentice at the Mt. Clare shops of the Baltimore & Ohio and subsequently was consecutively journeyman-machinist, inspector of engines and inspector of materials on the same road. From August to November, 1893, he was draftsman at the Richmond Locomotive Works and then for two years was general outside inspector of the same works. From November, 1895, to June, 1898, he was assistant superintendent of the Richmond Locomotive & Machine Works and then to April, 1901, was superintendent of motive power on the Atlantic Coast Line. He then organized and became president of the T. H. Symington Company, with a plant at Corning, N. Y. In 1908 he reorganized the company and built one of the largest malleable iron plants in the country at Rochester. In 1916 he organized the Symington Machine Corporation, Rochester, for handling large shell contracts for Great Britain and Russia. Two years later he extended the operations of the machine company to handle government orders for shells and he organized and operated additional plants, including The Symington Anderson Company, to manufacture 75 mm. French model 1897 field pieces; also organized the Symington Forge Corporation to manufacture 75 mm. shell forgings and the Symington Chicago Corporation to manufacture 155 mm. shell forgings and machine shells. He was appointed assistant chief of ordnance in September, 1918, and since November of the same year, when he resigned his commission from the army, served as president of the T. H. Symington Company, malleable iron foundrymen and manufacturers of railroad equipment, with headquarters at New York.

Charles J. Symington, president, was born on February 2, 1883, at Baltimore, Md., and was educated at Amherst College. He entered the service of the T. H. Symington Company in 1908 as assistant manager, eastern sales, with headquarters at Baltimore, Md. In 1910 he went to Chicago as general sales agent and in 1912 was appointed vice-president in charge of sales, with headquarters in New York. He became president of the Symington Machine Corporation in 1918, with offices in Rochester and Washington; vice-president of the Symington Anderson Company, and vice-president of the Symington Chicago Corporation.

M. J. Keane, manager of the steam goods branch of the Canadian Fairbanks-Morse Company, with headquarters at Toronto, Ont., has resigned and organized the Valve Engineering Company, with office at 160 King street West, Toronto. The new concern will act as agents for the Pennsylvania Flexible Metal Hose Company, the Penberthy Injector Company, Spands & Witwyte, manufacturers of pressure packing for steam and gas engines.

CATALOGUES

BALANCING APPARATUS.—A small pamphlet has been issued by the Vibration Specialty Company, Philadelphia, Pa., describing briefly the service which this company is prepared to render and its balancing apparatus to eliminate vibration in heavy machinery. Several illustrations show rotors and crank shafts which were put in balance on equipment of this company.

VALVE FACING TOOLS, ETC.—An illustrated catalogue and price list of valve facing tools, ball check valves, solid and hollow balls, pneumatic tube welding machines, ball finishing tools for repairing superheater ball joints, pnuematic locomotive turntable motors, etc., products of the Draper Manufacturing Company, Port Huron, Mich., has been issued by this company and is known as Catalogue No. 7.

METALLIC PACKING.—A four-page folder, issued by Harry Vissering & Company, Inc., Chicago, describes and illustrates the construction of Crescent metallic packing for valve stems and piston rods of locomotives. This packing is made of four flexible pieces, all the points overlapping, and is adapted for use with either saturated or superheated steam.

AEROIL THAWING OUTFITS AND TORCHES.—Bulletin No. 10 has recently been issued by the Aeroil Burner Company, Inc., 400 Main street, Union Hill, N. J. This illustrates the Aeroil thawing outfit and shows their application in thawing out hoppers of coal cars. The outfits are designed especially for use in the removal of ice and snow from frozen coal, sand and ore cars, hoppers, pockets, tracks and switches, etc.

DRILL SIZES FOR THREADED HOLES.—The Western Tool & Manufacturing Company, Springfield, Ohio, has issued a card which will be found useful for determining the proper size drill to be used for holes that are to be tapped. It gives the drill sizes for machine and hand taps from 1/4 in. to 2 in. for the various numbers of threads per inch commonly used and also the sizes for pipe taps and machine screws.

PULVERIZED COAL FOR LOCOMOTIVES.—The Fuller Engineering Company, Allentown, Pa., describes its equipment for burning pulverized fuel on locomotives in Bulletin No. 21. Figures are given covering the cost of drying and pulverizing coal and of installing a pulverizing plant. The advantages of this method of firing locomotives are described and sectional drawings show the equipment applied to locomotives.

HIGH SPEED ALLOY STEEL.—An attractive cloth bound book of 92 pages, 4 in. by 6 in., entitled Catalogue and Hints on Steel, is being distributed by the Halcomb Steel Company, Syracuse, N. Y. This catalogue contains a brief description of the company's various grades of crucible and electric tool and alloy steel and their uses, with instructions for treating. It also contains a large number of tables of useful information on areas, weights, etc.

MALLEABLE IRON.—The American Malleable Castings Association, Cleveland, Ohio, has prepared a short treatise on malleable iron, explaining its structure, uses and treatment, and indicating a few of the principles on which the process of making malleable iron castings is based, as well as some of the results that have been attained. The booklet is illustrated with a number of photographs showing results of various kinds of tests to determine the strength of the material.

TANK FRAME LOCOMOTIVES.—In Record No. 94 the Baldwin Locomotive Works describes tank frame locomotives for narrow gage railways. These locomotives have been designed for operation on rough tracks and sharp curves and are particularly suitable for industrial, contractors and other classes of special service. Illustrations of a number of locomotives of this type built by the Baldwin Locomotive Works are contained in the booklet, with tables showing their general dimensions.

WELDING AND CUTTING EQUIPMENT.—The Carbo-Hydrogen Company of America, Pittsburgh, Pa., has issued nine bulletins bound in a folder, describing cutting and welding torches and tips, regulators, and a portable cutting outfit mounted on a truck. All of the parts for carbo apparatus are catalogued in one of the bulletins and another contains directions for operating carbo cutting torches, bringing out some points that should be carefully observed when operating any cutting torch.

HIGH TEMPERATURE CEMENT.—Hytempite, a material for bonding firebrick and kindred uses, which is manufactured by the Quigley Furnace Specialties Company, New York, is described in a pamphlet entitled Hytempite in the Foundry. This material can be used as a binder wherever fire clay, silica brick or tile are used, requiring no heat to effect a bond between materials jointed. A number of applications of Hytempite in foundry work are described, with directions for applying the material.

STANDARD LOCOMOTIVES.—The Locomotive Superheater Company, New York, has compiled and published in Bulletin No. 7, general arrangement drawings and details of construction, together with a photograph and general data for each of the 12 types of standard locomotives designed by the United States Railroad Administration. Wheel loading and clearance diagrams for each are also given, making it a convenient reference book for information pertaining to the standard locomotives.

CHAIN DRIVES.—"A Chain of Evidence" is the title of a 20-page illustrated booklet published by the Morse Chain Company, Ithaca, N. Y., describing the construction of Morse silent chains, a distinguishing feature of which is the "rocker joint," consisting of a rolling or rocking bearing in each joint, which permits a rolling friction in place of the sliding friction common to other types of joints. Among a number of illustrations of large power drives is one showing the largest chain drive in the world—of 5,000 h.p. for hydroelectric purposes.

CUTTERS, ETC.—The Cleveland Milling Machine Company, Cleveland, Ohio, has revised its list of cutters in Catalogue B. This catalogue contains 140 pages, giving standard sizes and prices, and illustrating the line of tools, such as cutters, end mills, collets, hobs, etc., made by this company. Many valuable tables are contained in the catalogue, including tables of cutting speeds, corresponding diametral and circular pitches, decimal and millimeter equivalents, drill size decimal equivalents, screw threads and spur gear tooth spacing and thickness.

SUPERHEATERS.—Two circulars dealing with the maintenance and operation of superheaters are being distributed by the Locomotive Superheater Company, New York. Bulletin No. 6 is entitled "The Most from Superheating" and contains a reprint of the committee report of the Traveling Engineers' Association on superheating locomotive performance. Bulletin No. 8 contains instructions for properly maintaining and operating superheaters. It deals with such matters as lubrication and drifting, flue cleaning, handling units during repairs, etc. Another bulletin, No. 5, describes the company's model "496" pyrometer equipment for locomotive service.