AMERICAN ENGINEER

CAR BUILDER AND RAILROAD JOURNAL.

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The Mexican Central is in the market for 150 box and 50 stock cars.

The Duluth, Missabe & Northern has ordered 400 new ore cars.

The Metropolitan Elevated Railroad of Chicago, has ordered 25 new passenger cars.

The Chicago & Grand Trunk is about to order four passenger cars.

The Cleveland, Cincinnati, Chicago & St. Louis will shortly order six parlor cars.

It is stated that the Pennsylvania Railroad is about to order 2,000 new box cars.

The Louisville, New Albany & Chicago Railroad has recently ordered 100 new stock cars.

The Portland & Rochester Railroad has ordered 15 new gondola coal cars of 60,000 pounds capacity.

The Toledo, St. Louis & Kansas City will shortly purchase 500 gondola cars.

The Peru (Ind.) shops of the Erie Railway, have just completed 50 refrigerator cars for a brewing company in Cincinnati.

The New York, New Haven & Hartford has increased the wages of freight brakemen west of New London from $1.90 to $2 a day and firemen from $2 to $2.10.

The Southern Pacific discharged several hundred men employed in its shops at Sacramento, on Dec. 7. The force was reduced about one-fourth.

The Denver & Rio Grande is having 550 new freight cars built for early delivery. They are to be of 60,000 pounds capacity.

The four boys who wrecked the fast mail train on the New York Central in November are being held for trial on the charge of murder in the first degree.

The Midland Terminal Railway completed its road to Cripple Creek Dec. 19, and the first train from Denver ran direct into the town on that day.

An express car in transit on the Pennsylvania road caught fire and was consumed Dec. 18, all its contents being destroyed except the safe.

The boiler of a Pennsylvania Railroad locomotive exploded at Princeton Junction on the night of December 23, instantly killing the engineer and wrecking several cars.

It is stated that a large concern for the manufacture of street cars will be built near Steubenville, O., by capitalists from Chicago, Pittsburgh and Wheeling.

The Midland Terminal Railroad, of Colorado, is in the market for five locomotives, and will also soon purchase 10 passenger cars and 100 freight cars.

The Boston & Albany is about to order several locomotives similar to the Schenectady locomotives built last year for handling the limited trains between Springfield and Albany.

What is said to be the largest pane of plate glass in the country is in a window in Hartford, Conn. It was made in Belgium, and is 12½ feet high, 15½ feet wide, half an inch thick, and weighs 1,800 pounds.

The Illinois Central will soon order an additional 200 cars. The specifications include the American steel freight car truck manufactured by the American Steel Foundry Company of St. Louis.

It is now reported that Mr. Webb will remain in the London & North Western Railway as its mechanical engineer, the rumors of his retirement being apparently groundless.

The Northern Pacific earned nearly $400,000 more in November last than in November, 1894. The statement just issued is as follows: Net earnings, November, 1894, $783,019; November, 1895, $1,178,592; increase, $395,573.

The approximated gross earnings of all lines of the Atchison, Topeka & Santa Fe Railway for December were $813,608; for the same period of 1894, $759,772; increase, $53,836.

The dedication ceremonies of the new engineering laboratory of Purdue University, Lafayette, Ind., were held Wednesday, Dec. 4. This building replaces the old laboratory which was destroyed by fire on the night of Jan. 23, 1894.

It is stated that the new Board of Directors of the Atchison road has abrogated the old agreement with the Pullman Company, and that it will probably follow the example of the St. Paul road in running its own sleeping cars.

The United States Car Company has secured an order from the Chattanooga Southern Railroad Company for 100 cars, which will be built at the Anniston shops. This plant has just been made ready for operation, after being closed about two years.

Late in December a report was current in Baltimore to the effect that a consolidation of the Baltimore & Ohio Railroad and the Southern Railway is among the possibilities of the near future. This would be a transaction of the greatest magnitude and would combine in one vast system nearly 7,500 miles of road.

The fiat has gone forth that in future all carriages run upon the West Coast Scotch expresses shall be bogie vehicles; all the six-wheeled and radial axle box stock is to be withdrawn, and all the eight-wheeled carriages with radial axle boxes are to be sent to Wolverhampton and put on bogies.

A meeting of the stockholders of the New York and Long Island Railroad was held on Dec. 15 in New York. It was voted to increase the capital stock of the company from $100,000 to $20,000,000. The plan is to construct a railroad tunnel from Long Island City under New York to Jersey City.

Tramps have been making sleeping quarters of the depots along the Philadelphia & Reading Railroad. Several small stations have been burned. The officials of the road had a raid made on the tramps recently, capturing 31. They were taken to Norristown and placed in the workhouse.

The Baldwin Locomotive Works are building an eight-wheel locomotive for the Jacksonville, Louisville & St. Louis Railroad. The engine will have 17 inch by 24 inch cylinders, and will weigh about 96,000 pounds, 60,000 pounds of which will be carried on the drivers, which are 63 inch diameter and have Baldwin wrought iron centers.

The Delaware, Lackawanna & Western is becoming famous for its frequent and disastrous train wrecks. On Dec. 15 it experienced a rear end collision of freight trains near Dover, N. J., that instantly killed a stockman and a large number of live stock. A locomotive and several freight cars were wrecked.

Is there to be no limit to the development of the trolley car? There are trolley postal cars, trolley party cars, and trolley theater cars are promised. And now comes forward a genius who seriously proposes to run trolley lunch or dining cars, enabling busy men to take their meals while on their way to or from business.—*New York Tribune.*

The Westinghouse Air-Brake Company on Dec. 9 filed in the United States Circuit Court for the District of Maryland a complaint in a new action against the Boyden Brake Company for infringement of patent No. 360,070. This suit is understood to be directed against the new triple valve which the Boyden Company is now manufacturing.

A bill has been introduced in the United States Senate by Senator Quay, asking for an appropriation of $25,000 for the Franklin Institute and Purdue University, for the purpose of determining the quantity and effect of hammer blow, "centrifugal lift and tangental throw" of locomotive wheels in use on American railroads; also the effects produced thereby.

While a passenger train on the Siberian Railway was running at a high rate of speed, Dec. 19, the carriage in which Count Golovine was traveling with his wife and two children caught fire. The flames spread so rapidly that the Countess and her two children were unable to escape, and were burned to death. The Count saved his life by leaping from the train.

The American-China Development Company filed articles of incorporation at Trenton, N. J., Dec. 20. The avowed purpose of the corporation is to operate railways, steamship, telegraph and telephone lines in China. The capital stock of the company is $1,000,000. Among the corporators are Frank Trenholm, of New York; D. H. Lyon, of Greenwich, Conn., and S. S. Walters, of Jersey City.

The Pennsylvania Railroad is building from a point on the New York division near North Penn. Junction to Bustleton, from which an extension will be made about 16 miles to the vicinity of Trenton. The completion of this branch will give it almost an air line between Trenton and Philadelphia. It will be used specially for fast trains. Surveys are being made with a view to cutting off about a mile between Harrisburg and Altoona.

The proverbial three wrecks occurred on the Norfolk & Western Railroad, in Virginia, between midnight and morning, Dec. 11. The first occurred at the Norfolk & Southern Junction, a few miles west of Norfolk; the second near Windsor, and the third about three miles from Ford's Station. The trains were freights, and almost 20 cars were wrecked. The tracks were badly blocked, and all trains were delayed from two to three hours. No one was injured.

A French journal describes a new and promising substitute for gold. It is produced by alloying ninety-four parts of copper with six of antimony, the copper being first melted and the antimony afterward added; to this a quantity of magnesium carbonate is added to increase its specific gravity. The alloy is capable of being drawn out, wrought and soldered just as gold is, and is said to take and retain as fine a polish as gold. Its cost is a shilling a pound.

The New York State canals were officially closed on Dec. 5. In spite of low railroad rates, the past season has been a fairly good one for the boatmen. The total falling off in tons carried on all the canals during the season of 1895 was only about 10 per cent. In 1894 the number of tons carried was 3,882,560. This year, up to Dec. 1, the number of tons carried was 3,467,848, a loss in tons of 414, 712. The clearance since December will reduce the difference somewhat.

The *Railway Herald* says: The West Coast Joint Stock is to be increased by 100 new bogie carriages, which are to be built at the London & North Western Railway works, at Wolverton. We trust that they will be fitted with that system of spiral suspension bolster springs already adopted by the London & North Western Railway, which gives much better results with regard to steady and smooth running than the ordinary elliptical laminated springs formerly in use.

The production of pig iron in 1895 has verified the predictions made early in the year that if the rate of output at the time was maintained for the year the record of tonnage would be exceeded. The total output according to official figures compiled by the *American Manufacturer*, shows a production of 9,387,639 tons, exceeding 1890, the largest previous year, which had a tonnage of 9,202,703 tons. In 1892 the output was 9,157,000 tons. The tonnage of 1894 is exceeded by 730,251 tons.

All efforts to straighten out the Northern Pacific receivership tangle have proved unavailing. Repeated conferences have been held, but each succeeding discussion has widened the gulf between the Eastern and Western interests. Authentic information states that the Eastern interests which seem to be opposed to Judge Hanford have determined if possible to secure the passage of a law by Congress this winter, the effect of which will be to deprive Judge Hanford of jurisdiction. This, it is said, explains the long delay in approaching the adjustment of the united receivership of the road.

A happy instance of possible justice being tempered by sure mercy was the Thanksgiving proclamation of Superintendent Charles A. Beach, of the Buffalo division of the Lehigh Valley Railroad, stating that: "The Thanksgiving of such employees as have, unfortunately, been suspended for infractions of discipline, may not be a disappointing one, all such are hereby notified that the balance of their term of suspension need not be served; they may resume work at once." We are sure that the interests of the company were advanced by this act quite as much (and in dollars and cents much more) as were those of the employees concerned.

Truckee, a little town on the Central Pacific, which is very near the Nevada line and also very close to the summit of the Sierra Nevada range, proposes to open on Jan. 1 an ice palace which will have some novel features. There will be toboggan slides and skating ponds, but what makes it unique is that only 80 miles away, at Newcastle, orange groves will soon be in bloom and the trees now hang heavy with the golden fruit. The difference between the two places is solely the difference of altitude, but it is doubtful if any part of the world, except Hawaii, can afford such remarkable contrasts of climate within the same distance. Truckee also promises sleigh rides to Lake Tahoe, one of the most beautiful sheets of water in this untry.

Construction and Maintenance of Railway Car Equipment. I.

BY OSCAR ANTZ.

About seven years ago a series of articles was published in these columns, and afterward in book form, by Mr. Wm. Voss, on the construction of railway cars. These articles covered the subject pretty thoroughly as far as the cars then in use were concerned, but since then the demand for cars of larger carrying capacity and greater strength, and of others adapted to different purposes, has brought about changes in the dimensions and design, and in some cases has led to new types of cars differing from those then in existence.

The natural tendency to progress and improvement has brought into use a large number of appliances of more or less meritorious design, and the necessity of equipping freight cars with power brakes and automatic couplers to comply with national legislation has filled the market with the results of the ingenuity of inventors; and it will be the purpose of this and some subsequent articles to describe the improvements made in railway car equipment in the last few years, and to outline the possible changes which may take place in the near future. It is not intended that these articles should be an elaborate description of every kind of car in use, but merely to give a general idea of the best practice as it exists today in this country in the construction of railway cars.

later years, when many cars were built by car manufacturers and not by the railroad companies each one of these manufacturers had his own ideas and as they were usually not restricted to any details further than perhaps the kind, size and cost of the cars, the result was that if they patronized different manufacturers, railroad companies often had a great variety of such equipment.

Therefore, we find among the older cars almost as many different kinds as there are numbers, and when it is necessary to renew any part the old piece must often be obtained to make the new one from it. Very few drawings were made in those days, and each part had to be put in place before the next one was started. Castings and forgings were made to fit as occasion would require, and, especially where a foundry was conveniently near, each car often had some casting peculiar to itself.

At the present time, with the enormously increased number of cars and the large amount of interchanging of traffic between different roads, the question of repairs has become quite a serious one, and cars are now built so as to facilitate as much as possible the repairs of such parts as most frequently fail in service. Furthermore, the same parts in different kinds of cars are made alike whenever possible. Castings especially are reduced in variety, and even in the early days of the Master Car Builders' Association standards were established for a number of castings which were adopted by many roads.

Some of the standards for certain parts were, however, not established by the Master Car Builders' Association

There is still a wide discrepancy in the size and shape of similar parts of cars on different roads, and in the limited description which can at best be given in these articles, only such as seems to be the average good practice will be touched upon.

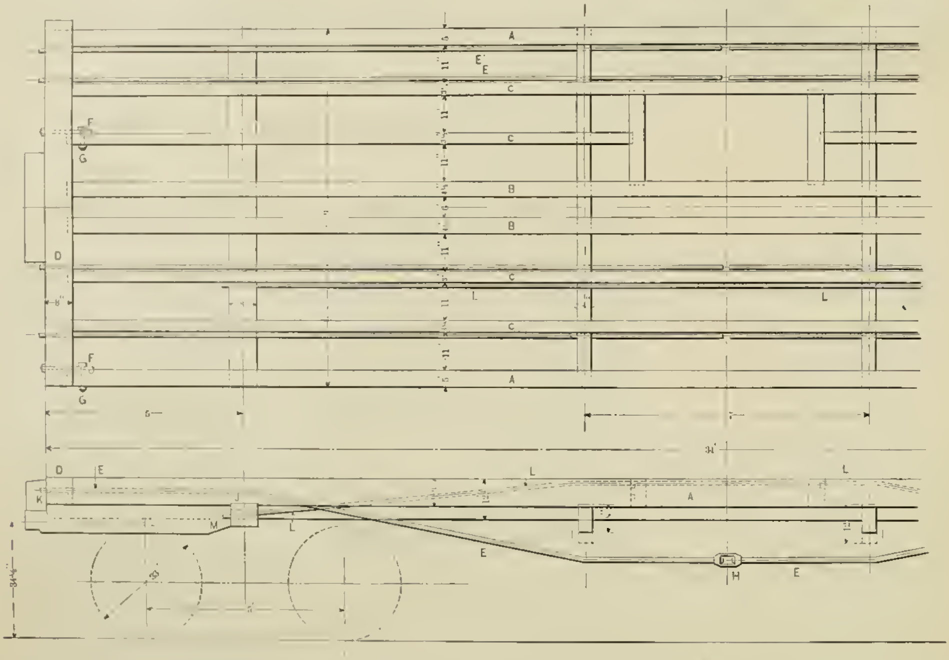
CAPACITY.

Nearly all freight cars that have been built in later years have a capacity of 60,000 pounds or more, and probably it will be but a short time before most cars of smaller size will be taken out of service or be assigned to remote divisions where the traffic is light, or to some special service in which they will not be put into the same trains with heavier cars. Some cars of over 60,000 pounds capacity are at present in use; ore cars of 80,000 pounds capacity have been in use for several years on a number of roads; coal cars of a capacity of 70,000 pounds have recently been built in considerable numbers by another road, and the building of cars of 80,000 pounds capacity for regular service is receiving serious consideration throughout the country.

These large cars may, however, be considered as yet in the experimental stage, and they will be treated by themselves later on; in the description immediately following only cars of 60,000 pounds capacity will be considered.

DIMENSIONS.

The length of a 60,000-pound freight car is generally from about 34 to 36 feet long over its end sills; the former length is largely adopted by roads which do not use an end platform; the latter length is necessary with end platforms to get an effective inside length of about 34 feet.



FIGS. 1 AND 2. SHOWING COMMON ARRANGEMENT OF FLOOR FRAMING AND TRUSSING OF FREIGHT CARS.

It is, furthermore, not pretended that very much, if any, new matter will be presented, as nearly every new car which has been put into use in the last few years has been more or less described and illustrated in the railroad and engineering journals, and a series of articles like these can only give in a general way the improvements made over the old practice, and the latter must be referred to at times to illustrate the new methods.

UNIFORMITY IN CAR CONSTRUCTION.

With the developments of modern railroading and the large amount of interchanging of cars among the different roads the necessity for uniformity in their different parts and especially of those used in freight service, not only of one road but of all railroads of the country is made more and more apparent, and the standardizing of such parts of passenger and freight cars as are most liable to damage and thus needing replacement, has been a most important part of the work of the Master Car Builders' Association.

In the earlier days of railroading cars were built according to the ideas and prejudices, often, of the person in charge of the car department of the road for which they were intended, without much regard to others on the same or other lines, and without making much provision with reference to repairing them. The length of the cars was often determined by the length of the timber which happened to be on hand for sills and the size of many other parts was also dependent the material on hand. In

until some roads had adopted different standards of their own, and had built cars according to them. These roads were naturally not very desirous of changing to some other plan perhaps not better than their own, and we therefore find even in modern cars many variations from the M. C. B. standards, which make more or less trouble on roads which adhere strictly to these standards.

In order to avoid, if possible, this state of affairs in future, standards should be established in advance for cars differing in capacity from those now in existence, and which the requirements will from time to time demand, and the Master Car Builders' Association has already taken up the subject of standard parts for freight cars of 80,000 pounds capacity, which it seems from present indications will be one of, if not *the*, freight car of the near future.

It should be the endeavor of all car builders to follow these standards, when adopted, indiscriminately, even if necessary to discard a pet idea or former practice.

FREIGHT CAR CONSTRUCTION.

A description of those freight cars for the railroads of this country which have been built in recent years can be based on the supposition that the necessity for standardizing this equipment has been recognized by railroad managers and that the cars have been built in pursuance of this policy, the subject can then be treated first in general way, describing such parts as are usually alike in all classes of cars, and then taking up each class individually.

The width of these cars varies from 8 feet 6 inches to 9 feet over the side sills, depending somewhat on the attachments on these sills, as the width over all must be kept within certain limits.

In these dimensions there has been practically no change from lighter cars, those of 40,000 to 50,000 pounds capacity having been built of about the same size; the height, however, on cars with a superstructure has been generally increased.

The height is determined by the class of the cars and the service in which they are employed. Closed cars, having a roof and side doors can be built as high as obstructions on the road will allow, while open or gondola cars which must be loaded over the sides be low enough to be loaded with economy. These dimensions will be given under their proper heads.

There is a demand at present for box cars of a larger internal cubical space than that which the ordinary box cars have, and of the same weight carrying capacity. This demand is the result of an arrangement of freight rates by which certain minimum weights are charged for, on light and bulky material in car load lots, even when the load does not weigh the prescribed amount. Naturally the shippers of this kind of freight demand large cars and the "Large Car Question" is now receiving a good deal of attention from railroad men.

Furniture cars have been built by some roads to meet this demand and these will be described later. Their usua dimensions, which are given here for comparison, are: length, 40 feet over end sills; width, slightly less than 10 feet over all, and extreme height about 13 feet.

FLOOR FRAME.

The increased capacity of freight cars necessitated a general strengthening of parts, and we meet this first in the floor frame.

In Figs. 1 and 2 is shown a floor frame which can be taken as an average of ordinary cars, the length shown being 34 feet over end sills; the upper half of the plan view represents the frame of a car having a central opening for drop doors, the lower part showing one for a solid floor.

LONGITUDINAL SILLS.

The longitudinal sills are eight in number and are usually of yellow or Norway pine; they are almost universally 8 inches in depth, excepting on cars without any framed superstructure, on which the side sills, *AA*, are made stronger, generally 12 inches deep.

The width of these sills varies more or less with different builders, but is usually 4½ or 5 inches for center, *BB*, and side sills, *CC*, and 3½ or 4 inches for intermediates.

The spacing of the sills is determined somewhat by other details of the car, thus the center sills are spaced to suit the draft rigging, and the intermediates depend somewhat on details of body bolster and on truss rods for their location, but it is usually endeavored to get as nearly an even spacing as is possible, with the center sills in the line of greatest stress.

On cars having a low frame, such as furniture cars, it is furthermore necessary to space the sills so as to allow the car to move over sharp curves without having the wheels strike the sills. When a certain spacing has been decided on as a standard, it should be adhered to as far as possible even on cars of different width, the difference being allowed between the outside intermediate and the side sill: this will bring all parts of the body bolsters alike, excepting the ends. The longitudinal sills are framed to the end sills, *D*, usually by double tenons, and are held to them by the body truss rods, *E E*; additional strength is given by bolts, *F F*, passing through the end sills and ending in a plate and lug; the lug is let into the longitudinal sill and a bolt, *G G*, passing through the sill and plate, holds them securely. These lug bolts should always be provided where the end sill is unsupported for any unusual distance by truss rods, or when a truss rod does not come close to the side sill. In the latter case these bolts can be utilized to hold the corner plates, if these are used.

The floor frame of freight cars is subjected more or less to influences which cause it to rot, and this is especially the case where two pieces of timber are close together allowing water which gets in to remain there, as it does between the tops of sills and the bottom of the floor, and in the joints between the sills. To prevent this tendency to rot a liberal coat of "Fernoline" oil should be applied to these places before the timbers are put together.

END SILLS.

The end sills, *D*, of freight cars are subjected to severe blows and must be made very strong. They are usually made of oak, although in the South yellow pine is sometimes used.

End sills are not less than 8 by 8 inches in section and are often made larger than this. They are almost universally now framed to the ends of all of the longitudinal sills, thus extending to the extreme width of the car. Where they are not enclosed by sheathing, or where corner bands are not used, they should extend a few inches beyond the side sills.

TRUSS RODS.

With the general strengthening of the cars, the trussing of the frame has also undergone some changes and there are now at least four truss rods, which are 1¼ inches or more in diameter, with the ends enlarged so that the area at the bottom of the screw threads which are cut on them equals or slightly exceeds that of the body of the rod.

The rods are made in two parts, joined at the center of the car by turn buckles, *H*, with right and left hand screws; these turn buckles are prevented from turning, when screwed up, by pieces of wood passed through two or more of them, and held in place by bolts or lag screws through the wood on the sides of the turn buckles.

The truss rods pass under bearings or "queen-posts" on the cross-tie timbers, *H*, which are generally about 8 inches deep, then over saddles on the body bolster at *J*, and then through the end sills, *D* at *K*, where large washers are placed under the nuts on the rods. Some builders put cast-iron sockets in the end sills for the truss rod nuts to rest in, so as to have no projections over the face of the sill.

The bends in the rods should not come quite close to the saddles and bearings, as there is a liability of tilting these when the rods are being screwed up, if the bends come hard against the casting.

The location of the truss rods with respect to the longitudinal sills is determined somewhat by the attachments on the end sills, and furthermore they must be so placed that they will not come in contact with the wheels or other parts of the trucks. Other details which determine the location are doors in the floor and the air-brake apparatus. In the upper part of Fig. 2, the two truss-rods *E' E'* are shown between the side sill and outside intermediate, as they would come in the way of the doors if located nearer the center of the car.

It is usual to place the rods close to some of the longitudinal sills, so as to tie these well to the end sills and to get a good fastening for the truss-rod saddle.

Flat or platform cars, having no superstructure at all, are liable to be bowed up at the center when empty and placed between heavy cars when the train is suddenly stopped. To resist this tendency, inverted truss rods, *L L*, of ⅞ or 1-in round iron are therefore used, which rest in saddles on the cross-tie timbers. These rods are located as high as they can be between the timbers and the floor, and their ends pass through the body-bolsters at *M* with large washers and nuts bearing on these, the ends of the rods being enlarged for the threads.

CAMBER.

If the top of a car were made perfectly straight it would sag down at the center when loaded. The truss-rods resist this tendency to some extent, and to further stiffen the car it is given camber; that is, it is curved upward at the center to 1¼ to 1½ inches from a straight line. This camber is obtained usually by drawing the frame down at the ends by means of turn-buckles made fast to the floor of the shop and raising up at the center by jacks. On cars with a framed superstructure this camber is preserved by making the braces and posts of the proper length and by the introduction of tie and brace-rods, and the truss-rods are used as an additional means of holding the car up under load. On cars without any framed body the camber is preserved entirely by the body truss-rods.

When in service, body truss-rods should be tightened up frequently to preserve the camber and to prevent the wearing of the joints between the sills and the consequent racking of the car.

CROSS-TIE TIMBERS.

Cross-tie timbers do not add much to the strength of a car, being used principally to hold the longitudinal timbers in place laterally at the center of the car and keep them from spreading, and also to provide a support for the truss-rod bearings. They are usually made of the same material as the end sills, and are about 4 by 8 inches in section, and extend to the outside of the side sills; they are gained or notched out a half inch for each longitudinal sill. There are generally two cross-tie timbers to a car, spaced from 6 to 8 feet apart. Some cars are occasionally found with only one of these timbers at the center of the car.

When the side sills are deeper than the other sills of a car, the cross-tie timbers are also made correspondingly deeper, and are cut out the same amount under the side sills. The cross-tie timbers are fastened to the longitudinal timbers by ⅝-inch bolts, one at each timber, and some of these bolts usually hold the body truss rod bearings also. Some builders place the cross-tie timbers slightly out of plumb to better resist the pressure from the truss rods.

(To be Continued.)

Reading Reorganization Plan

The plan for the reorganization of the Philadelphia & Reading Railroad Company and its subsidiary companies was made public Dec. 15. Under the plan the following securities will be created: General mortgage 100-year 4 per cent. bonds, $114,000,000; non-cumulative 4 per cent. first preferred stock, $28,000,000; non-cumulative 4 per cent. second preferred stock, $42,000,000; common stock, $70,000,000.

The general mortgage will provide for the issue, if found desirable, of additional bonds to meet the outstanding Philadelphia & Reading terminal bonds and Philadelphia & Reading Coal and Iron bonds. The mortgage will be based upon properties or securities of all the lines of railroad owned by the company, 327 miles; various leasehold lines, 532 miles, and all property of the Coal and Iron Company representing nearly 200,000 acres of coal and timber land. It will also have the benefit of equipment, valued at about $10,000,000, but now subject to about $7,300,000 of car-trust obligations, which are to be acquired under the plan, and also the marine equipment of the company.

Of the bonds $20,000,000 will be used for new construction, additional equipment, etc., under carefully-guarded restrictions not over $1,500,000 to be used in any one year. Provision is made that, at any time after dividends at the rate of 4 per cent. a year shall have been paid for two successive years on the first preferred stock, the company may convert the second preferred stock at par, one-half into first preferred stock and one-half into common stock, and the amounts of these latter may be increased in conformity. The assessments are 20 per cent. on the first, second and third preference income bonds; 20 per cent. ($10 per share) on the stock, and 4 per cent. on the deferred income bonds.

As set forth in the plan, the annual fixed charges of the reorganized system will be about $9,300,000. An almost immediate reduction of nearly $500,000 per annum in these fixed charges will, however be effected through the refunding or extension of the various bonds shortly to mature.

The net earnings of the system for the last four years, terminating Nov. 30, have been: 1892, $12,472,190.60; 1893, $11,172,690.56; 1894, $9,830,971 33; 1895 (estimated), $9,624,123. With a syndicate of $18,000,000 behind the undertaking there can be no doubt of the ability to meet all financial requirements that may arise.

Master Mechanics' Association Circulars.

Locomotive Steps and Handholds.

The committee of the Master Mechanics' Association appointed to report upon the subject of steps and handholds on locomotives and tenders has issued a circular of inquiry in which the following questions are asked:

What form of steps and handholds do you prefer leading to gangway of cab?

Do you consider the common arrangement of a step, each, on back of engine and front of tender sometimes confusing and dangerous?

Do you favor the arrangement of wide steps depending from the front of tender frame, dispensing with the engine step?

What arrangement of steps and holds do you prefer leading (1) to the headlight, (2) to sandbox?

What form, if any, of steps and handholds do you use or recommend at back end of tender?

Please forward your replies, with such drawings or prints as may be convenient, to John Medway, Superintendent of Motive Power, Fitchburgh Railroad, Boston, Mass.

John Medway, H. Bartlett, J. T. Gordon, F. M. Twombly, G. H. Baker, Committee.

The following circular has been issued by the committee on

Driving-Box Wedges:

Have you ever had any experience with locomotives whose driving-boxes were not put up with adjustable wedges? If so, please give us the results of your observations.

Do you think that a close-fitting box put up between a shoe and a fixed wedge (that could be lined only by a machinist when occasion required), would be a better method of construction than the present one of a movable wedge?

If in favor of the stationary wedge, please say how ought the box to be fitted in order to give the longest mileage without risk of the box sticking when the engine is first turned out?

Will you, for experimental purposes, equip an engine with stationary wedge, and run it some four or five months, and report results to us?

Are not the majority of hot boxes (not hot journals) caused by enginemen setting up movable wedges too tight?

Now that so many side rods have bushed ends, and are therefore not adjustable as to length, is it not advisable to take from enginemen the power of varying the distances apart of the axle centers, as can now be done on an engine with movable wedges?

Do not stationary wedges break off fewer axle box flanges than movable wedges?

If stationary wedges were not used, or in other words, if new engines had the frame pedestals forged with parallel faces and then fitted with pedestal blocks paralleled in every way, so that the new pedestal blocks as they came from the milling machine could be used interchangeably, either front or back, up or down, would it probably increase the risk of failure on the road by fractures of the frames?

Under the above conditions, would the engine tend to come back to shop for repairs, having made less mileage than if equipped with wedges?

Also, under the above conditions, would engine be appreciably less economical in the use of steam, during, say the last half of her mileage?

Will our members oblige the Association, and this Committee, by early replies to the foregoing questions, addressing J. Davis Barnett, Stratford, Ontario, Can.?

J. Davis Barnett, B. A. Childs, T. J. Hatswell, R. Atkinson, R. E. Redding, Committee.

Location of Atchison's Officers.

The headquarters of the executive officers of the reorganized Atchison, Topeka and Santa Fe Railway Company will be located as follows:

In New York—Chairman of the Board, Aldace F. Walker; Comptroller, John P. Whitehead; Assistant Secretary, L. C. Deming, and Assistant Treasurer, George C. Goodwin.

In Chicago—President, E. P. Ripley; First Vice-President, D. B. Robinson; Third Vice-President, Paul Morton; Freight Traffic Manager, W. B. Biddle; Passenger Traffic Manager, W. F. White, General Freight Agent, W. A. Bissell; General Passenger Agent, George F. Nicholson; General Solicitor, E. D. Kenna, and General Auditor, W. K. Gillette.

In Topeka—General Manager, J. J. Frey; Secretary and Treasurer, Edward Wilder; General Superintendent, H. U. Mudge, and Superintendent of Machinery, John Player. In addition these officers will have their headquarters in Topeka. Chief Engineer, General Claim Agent, Assistant General Freight Agent, Assistant General Passenger Agent, Superintendent of Telegraph, and Tax Commissioner, Master Car Builder and Superintendent of Car Service.

Among the deep coal mines in Europe is one at Lambert, Belgium. Depth, 3,490 feet.

The Terre Haute Car and Manufacturing Company has passed out of the hands of an assignee and the plant will be put in readiness to begin work in January.

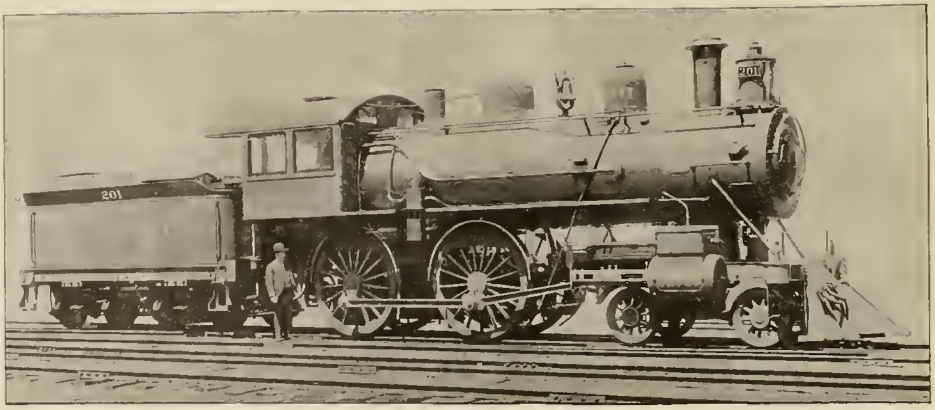
A despatch from Peking states that an imperial edict has been issued ordering the construction of a double-track railway between Peking and Tien-Tsin, a distance of 72 miles. The rails used will weigh 85 pounds to the yard and the cost of construction will be about $3,000,000.

Two Notable Locomotives.

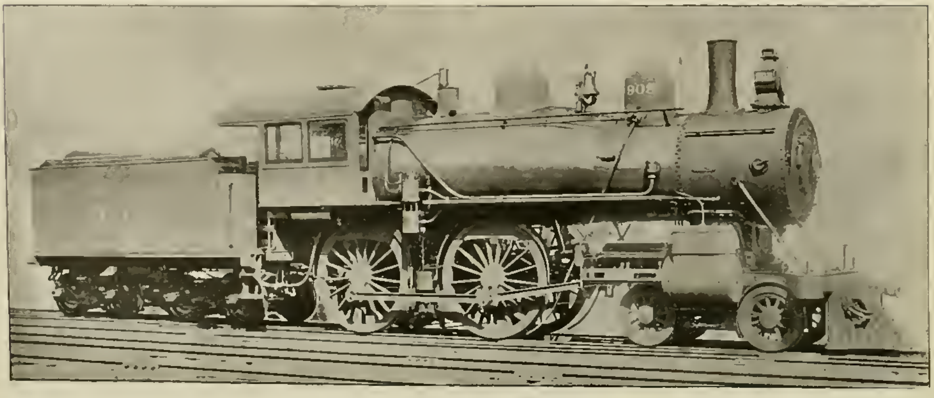
We herewith present photo-engravings of two powerful simple locomotives built for special heavy fast passenger service on Western roads. Both engines were built by the Schenectady Locomotive Works. Our first engraving shows one of two similar engines built for the Cleveland, Cincinnati, Chicago & St. Louis Railway. According to the designs of Mr. William Garstang, Superintendent of Motive Power of the road. These engines were procured to handle the heavy passenger trains on the grades of the Cleveland & Cincinnati Division from Cleveland to Galion. The train which they are designed to haul is No. 11, leaving Cleveland at 3:30 p. m. and arriving at Galion at 5:40 p. m. The distance covered in these two hours and ten minutes is 79.8 miles and there is a total ascent of 595 feet.

The great height of the engine above the rails prevented the placing of the safety valves on the dome and they were put back of it, as shown in the engraving.

Heating surface, firebox	179 sq. ft.
" " tubes	1,996 sq. ft.
" " total	2,175 sq. ft.
Grate area	30.75 sq. ft.
Drivers, diameter	72 in.
" material of centers	cast steel
Truck wheels, diameter	Steel tires, 33 in.
Journals, driving axle, size	8¾ × 11½ in.
Main crank pin, size	5½ × 6½ in.
Cylinders, diameter	20 in.
Piston, stroke	24 in.
" rod, diameter	3¼ in.
Kind of piston rod packing	Jerome metallic
Steam ports, length	20 in.
" width	1⅝ in.
Exhaust ports, length	20 in.
" width	3 in.
Valves, kind of	Allen Richardson
" greatest travel	6 in.
" outside lap	1⅛ in.
" inside lap or clearance	Line and line
" lead in full gear	⅛ in.
Boiler, type of	Radial stayed wagon-top
" working steam pressure	200 lbs.
" material in barrel	Carbon steel
" thickness of material in barrel	⅝ in.
" diameter of barrel inside	61 in.
Seams, kind of horizontal	Double riveted butt
" " circumferential	" " lap
Thickness of tube sheets	½ in.
" crown sheet	⅜ in.



Heavy Fast Express Locomotive; Cleveland Cincinnati, Chicago & St. Louis Ry.



Heavy Fast Express Locomotive; Chicago & Northwestern Ry.

One of the most striking features of its construction is the large boiler and firebox. The boiler is 72 inches in diameter, and the firebox is 9 feet long. The crown sheet is stayed with radial stays, the first two rows being sling stays. The dome is attached to the boiler by a flanged ring. The total heating surface is 2,175 square feet, about 245 square feet more than the 999 of the New York Central possesses.

The pistons and rods and driving-wheel centers are made of cast steel for lightness. The driver has a cast-iron ring, ¾ inch thick, shrunk on the inside of the hub. The design of the crosshead is for the standard four-bar guides used on this road. The pistons are hollow, and have a plate of boiler steel ½ inch thick as a cover on the head end. Dunbar packing is used. The engine truck is of the rigid-center type, with a wheel base of 70 inches. The center plate is of cast iron. The following table gives the general dimensions:

Kind of fuel to be used	Bituminous coal
Weight on drivers	83,000 lbs.
" " truck wheels	43,000 lbs.
" total	126,000 lbs
Wheel base, total, of engine	23 ft. 10½ in.
" " driving	8 ft. 6 in.
Height, center of boiler above rails	8 ft. 6½ in.
Tubes, number	320
" material	Knobbled charcoal iron
" outside diameter	2 in.
" length over sheets	12 ft.
Firebox, length	9 ft.
" width	3 ft. 5 in.
" depth front	76 in.
" " back	64 in.
" material	Carbon steel
" thickness of sheets	⅜ in.
" brick arch	Yes
" water space, width	Front 4 in.; sides 3½ in.; back 4 in.
Grate, kind of	Rocking finger, with drop plate
Smokebox, diameter outside	65 in.
" length	65¾ in.
Netting, wire or plate	Wire netting
" size of mesh or perforation	Three meshes per inch
Stack, straight or taper	Straight

Our second engraving shows one of 12 eight-wheel passenger engines recently built for the Chicago & Northwestern Railway for heavy fast service between Chicago and Council Bluffs. The trains hauled sometime consist of 11 cars, six of which are sleepers. While the average speed between terminals is not very fast, yet there are numerous stops, causing fast running between, making it an exceedingly hard service.

The driving wheels are 75 inches in diameter, and the truck wheels are 36 inches. The cylinders are 19 inches by 24 inches, and the firebox is 8 feet and $\frac{1}{16}$ inch long. The diameter of the boiler at the first ring is 62 inches and the height of center of boiler above rails is 8 feet 8 inches. The diameter of the piston is 3¼ inches, except where it enters the crosshead, and there the diameter is increased to 3½ inches. This was done to strengthen it at the point where the most frequent breakages have occurred. Cast iron gibs are used on the crosshead instead of brass ones. Cast steel is used in a great many places in order to get the necessary strength combined with lightness. The piston, crosshead, wheel centers, dome ring and deck plate are made of this material. The whistle is not put on the left hand side of the dome, as is frequently done, but is located at the same place as the safety valve. By this arrangement not only is the dome given a more symmetrical appearance, but should it be necessary to remove the covering, the boiler need not be blown off and the whistle removed. The interior arrangement of the cab is neat, half of the back head of the boiler being lagged and covered with planished iron. Platinum leaf is used for the numbers and lettering, and presents a handsome appearance.

The following gives the principal dimensions and points of interest:

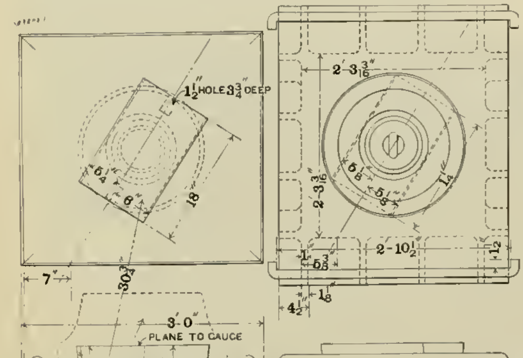
Kind of fuel to be used	Bituminous coal
Weight on drivers	78,000 lbs.
" " truck wheels	47,600 lbs.
" total	125,600 lbs.
Wheel base, total, of engine	23 ft. 7 in.
" " driving	8 ft. 6 in.
" " total (engine and tender)	47 ft. 6 in.
Height, center of boiler above rails	8 ft. 8 in.
" of stack	14 ft. 11 in.
Heating surface, firebox	159.3 sq. ft.
" " tubes	1,715.6 sq. ft.
" " firebrick tubes	28.8 sq. ft.
" " total	1,903.7 sq. ft.
Grate area	26.96 sq. ft.
Drivers, diameter	75 in.
" material of centers	Cast steel
Truck wheels, diameter	36 in.
Journals, driving axle, size	8 in. dia. × 11 in. long
" truck " "	6 in. dia. × 10 in. long
Main crank pin, size, main rod 6¼ in. × 5¼ in.; side rod, 4¼ in. dia. × 4 in. long.	
Cylinders, diameter	19 in.
Piston, stroke	24 in.
" rod, diameter	3¼ in.
Kind of piston rod packing	Jerome metallic
Main rod, length center to center	7 ft. 7¼ in.
Steam ports, length	20 in.
" " width	1⅝ in.
Exhaust ports, length	20 in.
" " width	3 in.
Bridge, width	1⅜ in.

Valves, kind of	Allen-Richardson Balanced
" greatest travel	6 in.
" outside lap	$1\frac{1}{8}$ in.
" inside clearance	$\frac{1}{8}$ in.
" lead	$\frac{1}{16}$-in. lap in full gear forward motion and back eccentric set to give $\frac{1}{4}$ in. lead at 6-in. cut-off forward motion.
Boiler, type of	Extended wagon top
" working steam pressure	190 lbs.
" material in barrel	Carbon steel
" thickness of material in barrel	$\frac{9}{16}$, $\frac{5}{8}$, $\frac{11}{16}$ in.
" diameter of barrel at first ring	62 in.
Seams, kind of horizontal	Multiple riveted, butt with welt inside and outside
" " circumferential	Double riveted
Thickness of tube sheets	$\frac{1}{2}$ in.
" of crown sheet	$\frac{3}{8}$ in.
Crown sheet stayed with	Radial stays 1 in. diameter
Dome, diameter	30 in.
Tubes, number	287
" material	Syracuse iron No. 11
" outside diameter	2 in.
" length over sheets	11 ft. 6 in.
Firebox, length	8 ft. $\frac{1}{8}$ in.
" width	3 ft. $4\frac{1}{8}$ in.
depth front	$77\frac{1}{2}$ in.
" " back	$65\frac{1}{2}$ in.
" material	Shoenberger steel
" thickness of sheets	Back and sides, $\frac{5}{16}$ in.
" brick arch? Yes	Supported on four 3-in. tubes
" water space, width	Front, $4\frac{1}{2}$ to 5 in.; sides, 4 to $4\frac{1}{2}$ in.; back, 4 in.
Grate, kind of	Rocking, with drop plate
Smokebox, diameter outside	65 in.
" length from flue sheet	$66\frac{1}{2}$ in.
Exhaust nozzle, single or double	Single
" " diameter	$4\frac{3}{4}$ in., 5 in. and $5\frac{1}{4}$ in.
" " distance of tip below center of boiler	$1\frac{1}{8}$ in.
Netting, wire or plate	Perforated plate
" size of perforation	$1\frac{1}{2}$ in. by $\frac{3}{16}$ in.
Stack, straight or taper	Cast iron, taper
" least diameter	Near bottom, 14 in.
" greatest diameter	At top, $16\frac{1}{2}$ in.
" height above smokebox	3 ft. $6\frac{1}{2}$ in.

Special Shop Tools.

Stack Base Dies.

Among the many other special tools that have been made and are in use in the shops of the Philadelphia & Reading Railroad at Reading, Pa., are the dies that are used under the steam hammer for stamping out the bases for the smoke-stacks. The one illustrated is that used for stamping the bases for 20 inch stacks. It will be seen to consist of a cast-iron matrix finished to the curve and outside diameter of the base. This is keyed to the anvil, while the stamp is keyed to the hammer head as indicated by the center figure on the left. The process is exceedingly simple, the heated plate is put over the matrix, and the head coming down forces it into shape. It is the impression of many that hydraulic pressure is alone suited for this class of work, but it is a mistake. A wide range of stamping and pressing can best be done with the steam hammer. The Schoen Manufacturing Co., for example, stamp out all of its center plates under the hammer, and do it with a rapidity that could not be approached by the hydraulic press. The same statement holds good with regard to these

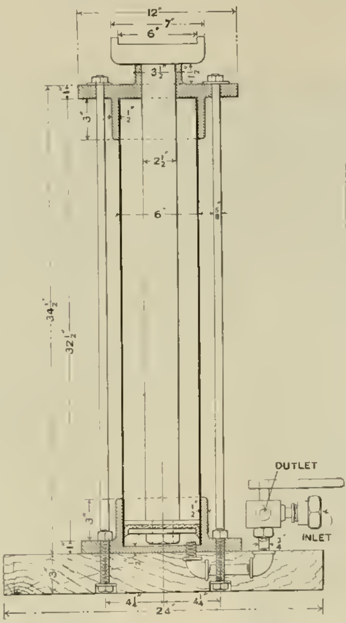


STACK BASE DIES

stack bases. As the dimensions are so fully given upon the engraving, any recapitulation of them is unnecessary.

An Air Hoist.

The hoist of which an engraving is here given is one that is in use in the West Albany shops of the New York Central & Hudson River Railroad for raising driving-boxes in the jaws. It is formed of a piece of 6-inch brass tubing set in castings at each end, and which form the top and bottom. They are held together by four $\frac{3}{4}$-inch bolts. The piston rod is a bar $2\frac{1}{4}$ inches in diameter with a $\frac{1}{2}$-inch plate and a cup-packing bolted to the lower end. At the top there is a casting having a shape suitable for holding the boxes.



AN AIR HOIST.

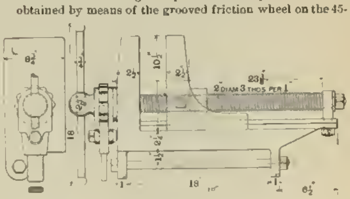
The whole is bolted to a 3-inch plank, having a passage-way cut out on one side for a $\frac{3}{4}$-inch air pipe leading into the bottom of the cylinder from a three-way valve of simple construction that has, on the inlet side, a screw connection for making the attachment to the main air-pipes running from the compressor.

A Spring Vise.

This is not a vise that is operated by a spring, but is designed to hold the leaves of plate springs while the band is being shrunk on. This is also in use in the Reading shops of the Philadelphia and Reading Railroad. Its construction as well as its principal dimensions are clearly shown by the engravings. It consists of a strong frame that includes one jaw and is rigidly bolted to a heavy block set in the floor. The screw is two inches in diameter and is fixed while the movable jaw with its nut moves over it. This jaw can be rapidly run up by the hand lever in the usual way and the final tightening secured by the ratchet lever to which a long handle can be attached. It is simple, strong, cheap, rapid in action and home-made.

Attachment for Slotting Boxes.

Here is another from the same Reading shops that are so rich in special contrivances. This is especially designed for slotting the curved face in driving-boxes, the tool is carried at the lower end of a spindle that is fitted, at the upper end, with a clutch engaging a worm gear. This worm gear meshes with a worm on the spindle shown in the plan as standing at an angle of 45 degrees with the center line of the machine. After the box is brought to a central position with the cutting spindle the tool can evidently be given a circular feed by turning a hand-wheel on the 45-degree spindle. The power feed is obtained by means of the grooved friction wheel on the 45-

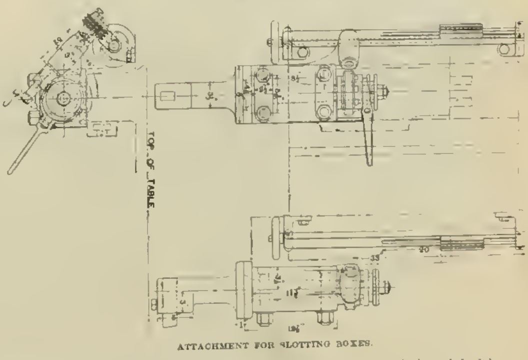


A SPRING VISE.

degree spindle. This rises and falls with the tool. On the vertical screw attached to the frame and which is clearly shown in the side and front elevations, there is, what might be called a friction rack. This can be raised and lowered by the vertical screw just alluded to and its position is such that the friction wheel runs into it on the rise, turns the 45-degree spindle and thus feeds the tool. As the friction contact is lowered the wheel moves over it for a greater distance and the feed is increased. As it is raised the feed is lessened, and it is stopped by slackening the frictional contact of the feed wheel.

Sleeping Car Rates.

As we announced in our last issue, agitation has been going on for some time looking to a reduction of sleeping car rates, and specially to a reduced rate for upper berths. About the best exposition of the folly of the plan are the following remarks on the subject recently made by an officer of the Wagner Palace Car Company. He said:



ATTACHMENT FOR SLOTTING BOXES.

"I say unqualifiedly that the sole practical result in doing this would be a net reduction in our earnings of about 20 per cent. with no advantage to the railroad company operating our cars, and practically no advantage to the traveling public. The rate for an upper berth between New York and Boston is $1, but the lower berths at $1.50 are invariably sold first. We have sleeping car tickets on sale in the same offices where the Boston and New York tickets are sold, and agents inform me that passengers are just as anxious to secure lower berths in the New York cars at a higher price than is charged for the upper, as they are to procure the lower berths in our sleepers on runs where the price of the uppers and lowers is the same. I feel certain that any one who gives the subject careful consideration must be convinced that an attempt to establish first and second class rates in a sleeping-car would not be successful, or appreciated by the travelling public. The ordinary travelling man is keen to secure a reduction in railroad rates that does not make a second-class passenger of him but the reduction in the price of upper berths would have, in my judgment, an entirely different effect. A passenger now buys an upper berth when the lowers are sold, on the basis of first come first served, and there is no question of caste, or first or second-class rates about the transaction. My experience warrants me in the belief that 90 passengers out of 100 would be in no way influenced by the fact of an upper berth being sold at a lower rate, while, on the contrary, I believe that in many cases it would absolutely deter passengers from buying upper berths, on the ground that they would not want to be regarded as going in for something cheaper than their neighbors in lower berths."

Campbell's Combination Freight Car.

In its last March issue, the NATIONAL CAR AND LOCOMOTIVE BUILDER published a brief general description of the combined stock, box and coal car designed in accordance with the suggestions of Mr. Robert B. Campbell, General Manager of the Baltimore & Ohio Railroad, and Mr. Howard Carlton, many of which are now in use on that road. We now present a more detailed description of this useful type of car than we then published, together with

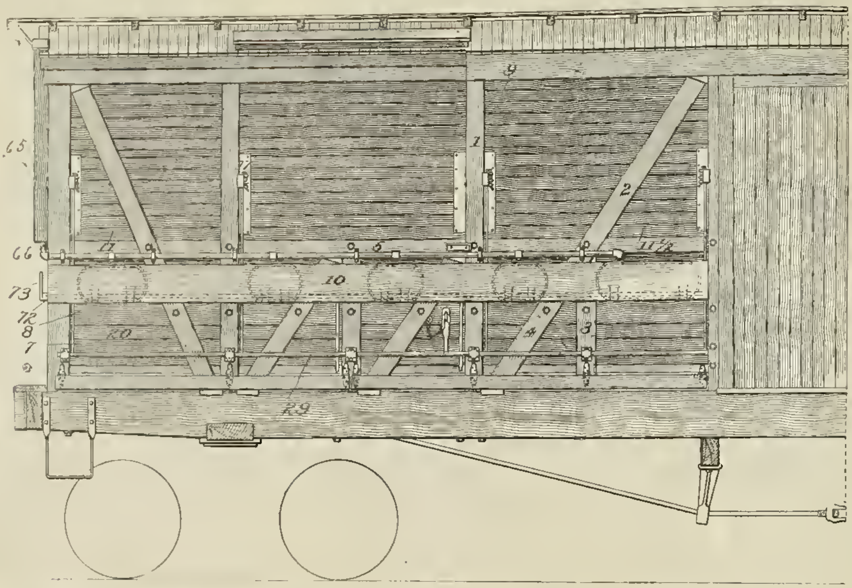


FIG. I. HALF OUTSIDE VIEW OF CAMPBELL'S COMBINATION STOCK, BOX AND COAL CAR.

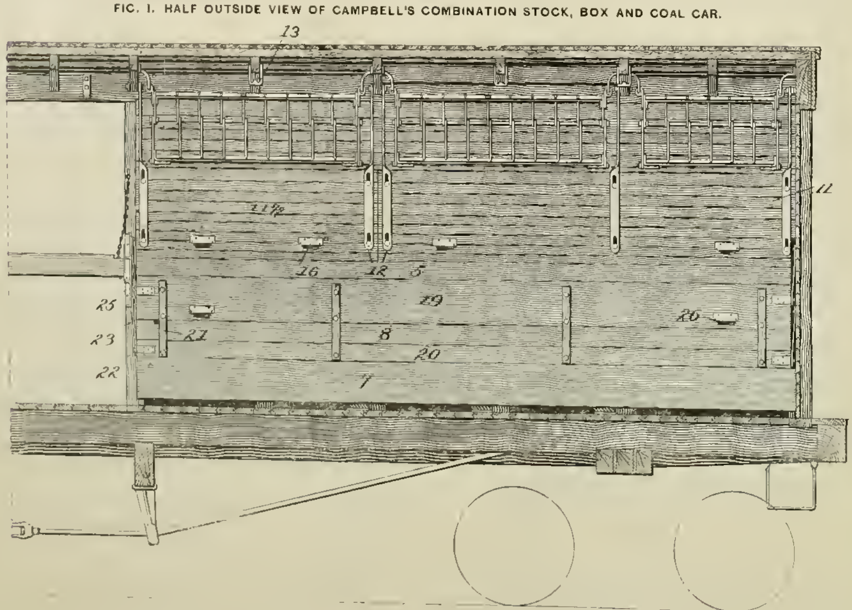


FIG. 2. HALF LONGITUDINAL SECTION, CAMPBELL'S COMBINATION CAR.

superior illustrations, which we are sure will prove of further interest to the readers of the NATIONAL CAR AND LOCOMOTIVE BUILDER while at the same time presenting much entirely new information to the readers of the AMERICAN ENGINEER AND RAILROAD JOURNAL, which papers are consolidated in this issue.

The main object sought in the construction of this type is to provide cars that can always carry a useful and paying load in which ever direction they run. The live stock traffic of the Baltimore & Ohio is very considerable, but it is nearly all an eastbound traffic. During the return trip to the West the cars are generally hauled empty, as they are unfitted for most kinds of westbound freight. Of course this haul is a dead loss, and it is to avoid such loss that this combination car has been designed. It can carry the eastbound live stock traffic most admirably, and it can carry all kinds of westbound traffic as well, whether it consists of merchandise, coal or coke, lumber, long or short, rods or grain. The advantages of such a car are so obvious that comment is unnecessary.

The mechanical construction of the car is such that it can be readily changed into the different classes of car, and is so constructed that it is strong and durable when used for any class of freight, and it is not an expensive car to keep in repair.

Fig. 1 is a view showing one-half of the outside of a car of this kind; Fig. 2, a longitudinal section; Fig. 3, an end view, and Fig. 4 a transverse section.

The sides of the car are of an ordinary form of construction, as shown in Fig. 1. The figure 1 designates the vertical posts by which the sills, 29, and plates are joined; 2, diagonal braces; 3, shut posts; 4, shut braces; and 5, a belt rail. Hooked straining rods are used in connection with these and constitute what is called a "bastard" Howe truss.

On the right hand side of the sectional view, (Fig. 4), a lining strip, 6, is shown, which is securely and permanently attached to the side frame posts, braces, and also to the girth or belt rail 5; 7 is a lower longitudinal lining strip located several inches above the floor, and 8 an intermediate lining, both of which extend from the side door to the end of the car, and are permanently fastened to the posts and braces. An upper longitudinal-tongued and grooved lining, 9, covers approximately one-half the area of the space between the girth and pate, and is permanently secured to the posts and braces. What is called the "lower adjustable side," consists of two panels or slots, 1 and 20, and is shown in its upper position on the right-hand side of Fig. 4. These slats are fastened together by iron cleats, 21. The edges of the slats and also those of the strips 9, 7 and 8 are made of an ogee form, so that they will engage with each other. This adjustable side is made removable, and can be fastened in the position in which it is shown on the right-hand side of Fig. 4, or it can be taken down and put in the position in which the slats 19 and 20 are shown on the left-hand side of Fig. 4. When it is in the former position, there are open spaces between the lining, 9, slats 19, 20, 6, 8 and 7, and the car is then adapted for carrying cattle.

If it was desirable to load it with coke or coal, the adjustable side 19 and 20 would be unfastened and removed from the position in which it is shown on the right of Fig. 4, and placed in that shown on the left side of the same figure, thus closing up the spaces between the slats 6, 8 and 7, and leaving that between the lining 9 and the belt rail open for loading the car. After it is loaded with this or other kinds of freight it is desirable to close this space. To do this, what are called the "upper adjustable sides" are provided. These consist of tongued and grooved paneling, 11, which is fastened to wrought-iron cleats or hangers, 12, which are pivotally connected to the rafters at a. By this means the paneling can be raised up against the roof, in the position shown on the right of Fig. 4, or when the slats, 19 and 20, are removed from their upper position it can be lowered into the position in which it is shown on the left of Fig. 4. It thus closes the opening completely, and its ogee-shaped edges make a tight joint with the adjoining slats. It will be seen that when the lower adjustable side is in the position shown on the left of Fig. 4 the whole side of the car is closed, and is made watertight by means of the ogee edges of the slats, and it is thus adapted for carrying merchandise freight. A number of ingenious devices have been provided for making this transformation and fastening the different parts securely in their different positions.

For the transportation of cattle, hinged troughs, 70, are provided, which are attached to a longitudinal rod, 72, Fig. 1 which can be turned by a crank, 73, so as to bring the troughs into the position for use as shown on the right of Fig. 4, or they can be turned upward as represented on the left side of this same figure. For carrying a supply of water, tanks, 65, Figs. 1 and 3, are provided which are connected by suitable pipes so that water can be delivered to each of the troughs.

Iron hay racks shown in Figs. 2 and 4 are also placed in the upper part of the car near the roof, with doors in the latter for supplying the racks. Ventilating doors, 64, Fig. 4, are placed in the ends of the car and also small sliding doors, 76, at opposite oblique corners for loading steel rails, long timber, lumber, etc.

Such a car can be used in carrying one class of freight in one direction and another class in the opposite direction, thereby, it is evident, enabling the transportation companies to reduce the empty haulage of their cars to a minimum and to practically double the carrying capacity of their common freight cars.

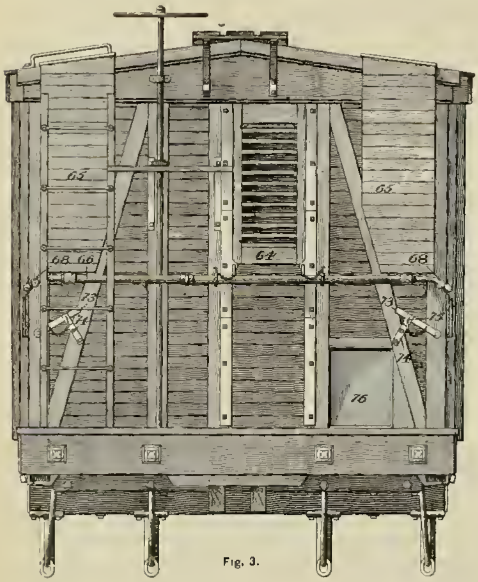


Fig. 3.

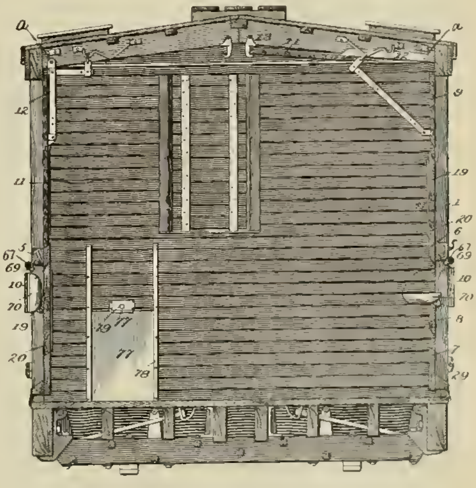


Fig. 4.

END VIEW AND TRANSVERSE SECTION, CAMPBELL'S COMBINATION FREIGHT CAR.

Pennsylvania Railroads.

Major Isaac B. Brown, Superintendent of the Bureau of Railways in the Department of Internal Affairs, of Pennsylvania, has prepared an interesting chapter for the forthcoming report of the Department, on the cost of railroads and equipment in that State.

An examination of the figures given shows that in the prosperous days of 1890, 1891 and 1892 there was a great increase made in the cost of roads and equipment. From 1890 to 1891 there were more than one hundred million dollars added to the cost of roads and equipment, and from 1891 to 1892, more than ninety millions. Here the tide changed and the annual percentage of increase in each of the three following years was very small compared with the years 1890 to 1891 and 1891 to 1892. From 1892 to 1893 the increase was about sixteen millions; from 1893 to 1894 about nineteen millions, and from 1894 to the close of the fiscal year, covered by this report, $11,855,800.

There are eight great railway corporations whose cost of road equipment is given at more than $50,000,000. These roads are the New York, Pennsylvania & Ohio, New York, Lake Erie & Western, Pennsylvania, Philadelphia & Reading, Pittsburg, Cincinnati, Chicago & St. Louis, Lake Shore & Michigan Southern, Western New York & Pennsylvania, Pittsburg, Fort Wayne & Chicago.

From the figures given by these corporations it is found that the average cost of road and equipment per mile of road has been as follows:

New York, Pennsylvania & Ohio	$396,988
Lake Shore & Michigan Southern	97,771
New York, Lake Erie & Western	302,396
Pennsylvania	219,705
Philadelphia & Reading	336,001
Pittsburg, Cincinnati, Chicago & St. Louis	85,861
Western New York & Pennsylvania	81,169
Pittsburg, Fort Wayne & Chicago	106,773

It is true that the railways of Pennsylvania have a greater capitalization, or show a greater cost per mile of road, than those of most other States, but there are cogent reasons for this apparent excessive cost. First, there is no State in the Union whose railways are so generally on the advance line of protection; and, second, there is no State in the Union where railway construction has been more expensive. Traversing and tunneling great mountains, bridging numerous and broad rivers, constructing double, triple and quadruple tracks, together with the expenditure of extraordinary amounts for the rights of way in rich farming regions and numerous municipalities, and the securing of the best terminal facilities, have made the railways of Pennsylvania show an exceedingly high rate of cost per mile of road.

No person conversant with the cost of railway equipment and railway construction can fail to observe the almost limitless cost of constructing and equipping the Pennsylvania Railroad. Its equipment is superb, and is always maintained in the most improved, substantial and perfect manner; its roadbed is perfect, and its stone and iron bridges are the best product of engineering skill. The design of the company seems to be to conserve the convenience, safety and comfort of its patrons. All these things have made the cost and equipment of the Pennsylvania road the high figure given above, but the security holders, the patrons and the citizens of Pennsylvania generally have the satisfaction of knowing that, although the cost has been enormously large, the "Pennsylvania" is acknowledged, both in Europe and America, to be the most perfect railway organization on the globe.

The extraordinary expenses that have made the Pennsylvania road cost so much per mile will apply in a great degree to other Pennsylvania companies. It cannot, however, be claimed that these causes have produced the high mileage cost of the New York, Pennsylvania & Ohio. Its line of road is through a territory where right of way was generally inexpensive, and it is but a single track line. It had no mountains to traverse, no great rivers to bridge, no expensive municipalities to deal with, and it certainly has never been burdened with expensive terminal facilities. Indeed it is hard to account for the high mileage cost of this road. The average cost of railways and equipment in the United States is not far from $63,000 per mile. By comparison with the cost of roads in this section, it will be seen that there is a great disparity. There are some short line roads in Pennsylvania whose average cost per mile is much greater than that of the New York, Pennsylvania & Ohio. This is due in most cases to the great expense incurred in procuring rights of way, and also to the fact that but little or no part of the line is inexpensive, and there is therefore no chance of reducing the average. For instance, the cost of construction alone of the Connecting Railroad is given as $509,805; the Ohio Connecting, $408,069; the Schuylkill River East Side, $818,181.

The cost of the Philadelphia & Reading Terminal, which includes the expenditure for one of the most magnificent and expensive stations in the world, and for the right of way through the city of Philadelphia, is reported as $7,926,031 per mile. This road is only a little over a mile in length. There are, however, only a few roads that have so high a degree of cost per mile.

An Extended Use of Copper.

Attention has often been called to the increase in the demand for copper, caused by the extension of electrical work in various directions. An instance of a new demand for the metal is found in the recently issued annual report of the Western Union Telegraph Company. The company, during the year ending with June last, added to its wire lines a net length of 11,859 miles, and over 10,000 miles of the new wire are of copper. The report states also that the company has adopted the policy of replacing all defective iron wires on its line with copper, the intention being to use that material alone on all the principal lines hereafter. The advantages of saving in weight, increased capacity for electrical transmission and diminished liability to interruption from atmospheric conditions are sufficient to make the copper wires more economical in the end, notwithstanding their greater first cost.

(Established 1832.)

AMERICAN ENGINEER

CAR BUILDER AND RAILROAD JOURNAL.

27th Year. 65th Year.

PUBLISHED MONTHLY
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GEORGE H. BAKER, Editor.

HERBERT W. POOL, Business Manager.

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Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* American Engineer, Car Builder and Railroad Journal *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 25th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* American Engineer, Car Builder and Railroad Journal *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

ANNOUNCEMENT OF CONSOLIDATION.

In the present number of this publication the National Car and Locomotive Builder has been consolidated with the American Engineer and Railroad Journal, with the title of American Engineer Car Builder and Railroad Journal. It will hereafter be published monthly under the editorial supervision of Mr. M. N. Forney, assisted by Mr. Waldo H. Marshall, heretofore editor of the *Railway Master Mechanic*, published in Chicago.

Mr. George H. Baker, who for the past four years has edited the National Car and Locomotive Builder, retires when this issue is mailed, and in doing so desires to express to each reader his appreciation of the support and courteous treatment he has uniformly received at the hands of the patrons of the paper. His thanks are specially due and are most sincerely tendered to the railroad officers in all parts of the country, who by their kindly help aided him in making the National Car and Locomotive Builder interesting and instructive to its readers. He came to the editorial chair from practical railroad work with high esteem for the sincerity, integrity and progressiveness of American railroad officers, and he retires with this sentiment strengthened and enhanced beyond question. No class of Americans excel in the possession, in high degree, of the first-named qualities, and the superior efficiency of American railroads and their equipment (especially their rolling equipment) to that of the railroads of the world, proves their progressiveness.

Sincerity and integrity of purpose are chief among the foundation principles of right living and of civilization. Progressiveness is the motor of civilization, conveying us always to better things in every walk of life. It is the spirit of Wordsworth's "Happy Warrior,"

> "Who, not content that former worth stands fast,
> Looks forward, persevering to the last
> From well to better—daily self surpassed."

It is the province of the technical railroad papers to promote this quality and herald its achievements; and in doing this they have done, and are doing, a work of incalculable advantage to railroad interests, to railroad men, and to the patrons of these leaders as well as servants of civilization. During its 26 years of existence the National Car and Locomotive Builder stood second to none in the quality and success of its efforts to fulfill its mission, within its scope, as indicated above; and during its last four years it was specially successful in promoting safer methods of passenger car construction, greater care of locomotive boilers, and the adoption of improvements looking to the more economical operating of locomotives.

REDUCING JOURNAL-BOX FRICTION.

The resistance of trains to being hauled constitutes the work that locomotives in overcoming it must perform. Any increase in this resistance is a tax upon locomotives, and any decrease in such resistance enables locomotives to perform more useful work (haul more cars or make better time) with the same expenditure of power. It is therefore evident that efforts to decrease train resistance are in the line of economy and greater efficiency. Train resistance is really made up of several "resistances," or it has several elements, such as the resistance of the air, the rolling friction of the wheels on the rails, journal-box friction and the inertia of the load. Probably the most susceptible to reduction of all these is journal-box friction. In cold weather this friction is greatly increased because of the viscosity of the congealed oil. We treated this matter at some length in the last (December, 1895) issue of the National Car and Locomotive Builder, and will not go into it again here further than to say that carefully conducted railroad laboratory tests have demonstrated that with a fall of temperature of 70 degrees the friction was doubled with the same oil. Dilution, preferably with kerosene, to a fluid consistency in actual service is the best remedy for this evil.

Our present purpose is to call attention to another possible means of reducing journal-box friction, and this is by giving to new axle-journals a smoother finish than is generally done before they are put in service. Persons familiar with the usual condition of new axle-journals know that they are much less smooth than journals that have seen some service. Actual service gives a smooth, high polish, the equal of which is not even attempted in most shops building new equipment or putting in "new wheels" beneath old equipment. In fact, it is commonly expected that new equipment will have hot axle-journals, and that "new wheels" in old equipment will "run hot." This is principally because of the commonly too rough surface of new journals. There are few mora potent causes of train delays than "hot boxes," and in this connection the experience of the Missouri Pacific Railway should be valuable to every person interested in the most efficient operation of rolling equipment. As we announced a year ago, it is the practice of the mechanical department of this road to give a high polish to the journals of all axles and crank pins before they are put in service, and we then illustrated (National Car and Locomotive Builder, January, 1895, and described a tempered steel roller of cheap and simple construction used for burnishing the journals. This roller burnisher takes no metal from the journal, but compresses the surface about .002 of an inch, and imparts a harder and smoother finish, and higher gloss than we ever saw imparted by the longest and most successful service. On the road named this method has been found to give the *sine qua non* for avoiding hot boxes.

It may be assumed as true that the harder and smoother any two surfaces are, the less will be the amount of friction between them. Watchmakers know that fine steel pivots, running in highly polished holes cut in the hardest jewels, give rise to the least amount of friction, and consequently such surfaces are always chosen for fine watches, as the disturbance of the motion is thus reduced to a minimum. An apparent exception to this is found in the case of Babbitt metal, which is comparatively soft. We do not attempt to offer any explanation of this apparent exception to the general rule—for an exception it certainly is. In selecting the material for axle and crank-pin journals it is important that the material be hard and close-grained. Open-grained surfaces will begin to cut sooner or later, and when once this action fairly sets in it is almost impossible to stop it. Where wrought-iron is used, it is important that the fibers of the bar of which the axle is made be thoroughly welded together. If they be left in a loose and fibrous condition, and the direction of the motion be at right angles to the direction in which the fibers run, it will be impossible to produce a smooth-running journal.

One of the greatest benefits conferred upon mechanics by the modern improvements in the manufacture of steel and iron is the introduction of a hard, non-fibrous material for journals. Common steel, good enough for all purposes except the making of fine edge-tools, can now be had at a very moderate price, and wherever a journal is required to give the best satisfaction, it should be made of steel.

In finishing the surfaces of journals, great care ought to be taken to avoid the use of emery. It is wonderful how readily the hard-cutting grains of emery and similar polishing substances become imbedded in iron, brass and other materials, and then act just like diamond drills. Every watchmaker knows that a copper wheel or disk smeared with diamond-dust will rapidly cut the hardest steel, and the action is the same in regard to all metal surfaces to which emery has been applied with considerable force, as in the ordinary process of polishing. Smoothness is an essential requisite in all surfaces that slide or roll one upon the other, but this smoothness ought in all cases to be attained by burnishing in the manner described, or by cutting with sharp steel tools, and not by polishing with grinding substances.

PASSENGER TRAIN DETENTIONS.

If there is one thing that the average traveler appreciates more highly than anything else, even placing it above comfort and safety, to say nothing of the luxuries of the limited express, it is the certainty that the train upon which he is journeying will arrive at its destination on time. Perhaps this is valued more highly in this country than elsewhere on account of the rarity of its attainment, for when a railroad officer asserts, as was done at the New York Railroad Club the other evening, that the result of an investigation of carefully compiled statistics leads to the conclusion that upon a great trunk line, provided with every facility for the moving of its trains, 34 per cent. of them are late, the general public is apt to think that a much higher average prevails on the majority of roads, even though it may not quite touch the point given by one speaker, where, out of some 275 trains used by him on a certain road between April and January, only one was on time, and that one, to put it in the form of an Hibernianism, was a minute late.

But whether the average is thirty-four or one hundred per cent. it is very certain that the proportion of trains arriving at destination behind time is very much greater than it should be, and certainly so far as our own personal observation goes, is very much greater than it is in European countries. If this is so, then our Yankee smartness seems to be of no avail, for what does it really profit the country that we run one train the fastest in the world if the other ninety and nine drag along into the terminals at intervals of from one minute to four hours behind the schedule?

At the meeting of the New York Railroad Club already referred to, it was shown that less than 11 per cent. of the train detentions were due to failures of equipment, and that the remainder can be laid at the door of the operating department. But to the passenger it matters little whether the locomotive looses a crank pin or the dispatcher his wits, so long as the train fails to carry out the contract virtually made by the company when, by the publication of its timetable, it promises to the traveler on train 10 that he shall reach A at 10:30 a. m., but does not land him there until noon.

He knows that something is wrong, but what he cannot always determine. Personal observations and personal opinions are always liable to the error of the personal equation and must therefore be carefully weighed before being accepted; and with this preface it seems to us that the great majority of detentions which we have been able to sift to their sources may be referred to as caused either by an overloading of the locomotive or the interference of the freight trains that have blocked the way of the passenger trains. This means bad judgment and bad despaching. It is poor judgment to schedule a train at a speed so high that the locomotive can just make time when all conditions are favorable, and that a slight rain, a head wind, a little more slate in the coal, an excursion of slowly moving country people, or an extra car, will mean a steady loss of time from one end of the division to the other. Yet this is just what we do see in everyday railroading. Roads running to competing points compete on time as well as rates, and from actual observation of accomplished facts we are led to the belief that, in some instances, the less favorably situated road, both with reference to motive power and profile of track, will crowd its through time down so as to meet the time of its competitor on paper, though the officers must know that they cannot fulfill their promises, and that their trains must run late.

Passengers will more readily take a train using 11 hours, on the timetable, to accomplish a certain journey if there is a certainty that 11 hours means 11 hours than they will a train taking 10 hours on paper with an equal certainty that that 10 hours means 10½, and it seems strange that railroad managers are so slow to appreciate this fact. Hence, if trains are overloaded there is but one remedy: apply more power. Either run two sections or double-head; but whatever it may cost, it will be found to pay to get there on time, and the moral of this first lesson is—do not overload the locomotive.

Regarding the second class of detentions, freight trains blocking the track, the first impression is that that means bad despatching, but as it is a general condition on almost every road in the country, whether it be single or double tracked, but especially in the case of the former, so, as the despatchers are men that, as a class, must rank above the average in intelligence and careful application and attention to business, we are led to inquire whether the duties of a despatcher are not beyond the limitations of the human mind to properly execute. When we know of despatchers issuing 800 orders in a trick of eight hours it appears that it is about time to shorten hours or change the system.

To change the system can mean but one thing and that is the scheduling of freight trains and instead of running them by telegraph, running them by timetable. Why not? The system has been tried and worked for years abroad and it would and should be more of a task to convince a European manager that the telegraph is the proper method of operating freight trains, than it would be to convert an American manager to the use of the schedule system. The one has the merit of success to recommend it. Passenger trains in France and Germany run on time and a careful observation of many hundreds of trains failed to find one that either arrived at destination or passed intermediate stations behind time. This does not mean that trains are never late, but that one observer has totally failed to catch a train in the act, a condition that no one, in this country, would fail in if the investigations were prolonged through a single half day. With this apparent record at its back and the facts as well known as they seem to be, it seems strange that the system has no foothold in this country. We acknowledge that the work of the compilation of time-table on a single track road doing a heavy business would be immense, but when once done it is at least finished for the season, and the relief to the despatchers would be even greater. To issue 300 orders in eight hours, is to assume responsibilities that are too great to contemplate, and to run risks that come very close to being criminal, and when we consider the actual mental capacity of the average despatcher we are led to a suspicion that the limit of elasticity of his capabilities are very frequently exceeded.

The operating department, stands confessedly convicted of the responsibility for most detentions to passenger trains, and if the majority of those detentions are due, as we believe they are, to the overloading of engines and the interference of freight trains, it certainly does seem that it would be worth while from a business standpoint and for the advantages that would certainly follow the reputation of running trains on time, to make an application of the two remedies that we have indicated and which have worked so well and produced such markedly good results on foreign railroads.

The series of articles begun in this issue on the Construction and Maintenance of Railway Car Equipment will extend through several months, and will doubtless prove of much practical interest to those connected with the construction and repair of cars. The author of the articles is Mr. Oscar Antz, General Foreman of the car shops of the Lake Shore & Michigan Southern Railway at Cleveland, O. Mr. Antz is a member of the American Railway Master Mechanics' Association. He graduated at the Stevens Institute of Technology in 1878, and obtained considerable practical experience in the Meadows shops of the Pennsylvania Railroad, and worked through different grades, including the shop and drafting room. He was then made General Foreman of the South Amboy shops, which position he held for three years, and afterward was Assistant Master Mechanic of the Meadows shops for three years. From the latter position he resigned to become Division Master Mechanic of the Central Railroad of Georgia, which position he held for two years.

Proposed Michigan Central Bridge at Detroit.

The Michigan Central Railroad has decided to erect a high bridge of three spans to cross the river at Detroit that connects Lakes Erie and Huron, and a bill has been introduced in Congress to provide for its erection. The main channel spanis to be not less than 1,100 feet in clear width between the masonry piers, of which there are to be only two, and the clear head-room for vessels under the spans is not to be less than 140 feet. The probable cost of the structure is estimated at $4,000,000.

The Michigan Central has long enjoyed the reputation of being unsparing in its efforts to please its patrons. The decision to build this bridge is another illustration of this predominant spirit. The passage of the Detroit River by ferry has always caused considerable loss of time and unpleasant switching. A bridge will remedy this, and prove an added attraction for travelers for this already exceedingly pleasant route.

Oil Fuel in the Navy.

The recently issued report of the Bureau of Steam Engineering to the Secretary of the Navy states that:

"By reason of our ability to secure a large supply of this combustible, a series of experiments should be made with petroleum to find out its value for torpedo boats and the smaller types of vessels. In order to make these experiments of any value they would have to be long continued in order that the various burners might not only be tested for efficiency but also for endurance. One of the gunboats now building at Newport News would be an admirable vessel for testing the merits of liquid fuel. The tests should not only be progressive but they should be varied. One of the particular questions to be determined would be how much increased power over that furnished by natural draft could be secured by burning the liquid in conjunction with coal. Another important question that might be solved would be the effect of the various fuels on the ends of the tubes. It is safe to say that valuable aid would be rendered by those interested in the development of the oil industry, and an opportunity has now occurred when the value of liquid fuel for naval purposes can be definitely determined."

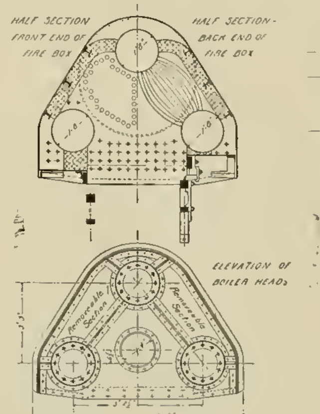
A Locomotive Water-Tube Boiler.

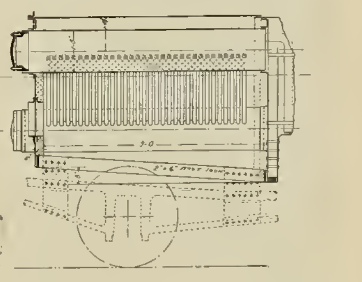
During the discussion of Mr. J. Snowden Bell's paper on Wide Fireboxes for Locomotives" at the November meeting of the Western Railway Club, Mr. William Forsyth, Mechanical Engineer of the C.,B. & Q. R. R., suggested the use of water tube boilers for locomotives to increase the possible heating surface without resorting to excessive boiler weight. The accompanying engraving reproduces drawings that show the proposed plan of such a boiler. In speaking of the matter Mr. Forsyth said:

"Mr. Bell says that in making boilers attention has principally been paid to enlarged heating surface, which is obtained largely through the tubes; the heating surface has not grown in proportion to the larger grate surface. In the Wootten boilers, which are so wide, the heating surface, to absorb the large amount to be burned on this grate, has not increased nearly as rapidly as the grate has increased. Now, in getting large capacity in a locomotive, we have, I think, nearly reached the limit to which we can go in a production of steam with these large boilers without enormously increasing the weight with the ordinary type of locomotive boiler.

"Recently Mr. Yarrow, in England, has built some torpedo boat destroyers, in which he has used water-tube boilers. In torpedo boats themselves he first used locomotive boilers, but when a speed service was required of 35 miles an hour he resorted to the use of a water-tube boiler; and they are also used in the various navies of the world where a large capacity is required in a compact space.

"It seems to me that in the development of locomotive boilers requiring much larger steam capacity, that a water-tube boiler might be made to be successful, and I have made a plan of something of that kind, in which I obtained a heating surface in the firebox of 579 square feet, which is from four to five times the heating surface in an ordinary locomotive firebox. In this design also there are no staybolts, except in the front leg, and the firebox can be made as the road limits will allow, so that, although that design





WATER-TUBE BOILERS FOR LOCOMOTIVES.

as it is may not be entirely practicable for locomotives, yet it meets the requirements of a large grate, of dispensing with staybolts almost entirely, and of providing an increase in heating surface much larger than the grate surface is increased."

Central Railway Club.

The next regular meeting of this Club to be held at the Hotel Iroquois, on Friday, Jan. 10, 1896, will be the annual meeting, at which officers will be elected for the ensuing year. The business session will be followed by a banquet in the evening. The tickets have been fixed at $3 (including one lady), and can be obtained from the secretary, who should be advised not later than Jan. 5, how many seats are desired at the banquet.

The following reports will be considered:

"When Locomotive Boiler Tubes require to be safe ended should the safe end be welded to the tube proper with a lap weld or butt weld, and in what respect is one method preferable to the other? What would be the comparative cost of these two methods?" Committee: J. H. MOORE, J. N. WEAVER.

"Injury caused by the Drippings of Salt Water from Refrigerator Cars to Track Bolts, Trucks, etc." Committee: A. M. WAITT, Chairman; JOHN S. LENTZ, C. J. BUTLER.

Committee on Nominations: A. C. ROBSON, Chairman; LAMOTT AMES, E. A. MILLER, EUGENE CHAMBERLAIN, J. A. CHUBB.

Committee to Arrange Annual Banquet: F. B. GRIFFITH, Chairman; W. H. GARDNER, E. A. BENSON, O. P. LETCHWORTH, BARRY D. VOUGHT.

Discussion will be had on the following:

Master Car Builders' Rules of Interchange, as revised at Pittsburg, by a committee composed of members of railroad clubs.

Topical questions submitted by members.

Exhibits at the Next Conventions.

The next conventions of the Master Car Builders' and Master Mechanics' Association will be held at Congress Hall, Saratoga Springs, N. Y., June 17th to 24th, inclusive.

It is the wish of the Joint Committee of the Associations that a very complete exhibition be made of all goods and devices used in their respective departments, particularly new and improved machinery, and especially air compressors, pneumatic lifts and tools. In order that such may be shown to the best advantage, it has been decided to furnish, free of charge to the exhibitor, steam, compressed air, and power, and it is very desirable that those intending to make an exhibit, apply for space as early as possible. The Standing Committee has contracted with Congress Hall for accommodations for supply men at following rates: Single room, $3 per day; double room, one person, $4 per day; double rooms, two persons each, $3 per day.

Exhibitors may have space reserved by applying to W. C. Ford, Secretary of the Standing Committee of the Supply Men's Association, Room No. 19, No. 29 Broadway, New York City.

A President's Private Car.

A special car for the use of President Stuyvesant Fish, of the Illinois Central Railroad Company, was recently completed and put in service. The car is 69 feet 6 inches long over the sills, and 10 feet ½ inch wide. Hinson combination platforms are used. The windows have double shades, white outside and dark inside. The dining-room is arranged to accommodate 12 persons at the table. There are three staterooms, each with private toilet rooms and dressers, and two of them have upright folding beds.

The inside finish of the car is in polished mahogany except at the rear end, where quarter-sawed oak is used. It is lighted with Pintsch gas, and is also wired for electric lights, electric heating and electric fans. The closets are of the Campbell-House pattern. The washstands and water coolers are white metal, and hammered scrap axles are used, and the trucks have 38-inch Krupp steel-tire wheels.

The Fastest Regular Train.

The New Central & Hudson River Railroad increased the scheduled speed of its Empire State Express on Dec. 4 from an average of 51 miles an hour to 53.33 miles an hour between New York and Buffalo. For more than four years this train has made its daily run of 440 miles in 520 minutes, including four stops and 28 slow-downs. Its new time of 495 minutes is not that of an experimental run, but is scheduled for daily service between New York and Buffalo until a further reduction becomes practicable. The speed of the best trains of foreign nations is: England, 51.75 miles an hour; Germany, 51.35; France, 49.88; Belgium, 45.04; Holland, 44.78; Italy, 42.34; Austria-Hungary, 41.75. America now heads the list with 53.33 miles an hour to the credit of the Empire State Express.

The Pacific Cable Company.

A meeting was held in New York, Dec. 7, to complete the organization of the above-named company. It will lay a cable in the Pacific Ocean to connect San Francisco with the proposed American naval station at Pearl River Harbor, Sandwich Islands, and to Japan, China, Australia and India. It is understood that the contract relations between the Western Union Telegraph Company and the English Atlantic cables expressly provide that the Western Union Company is free to use a Pacific cable route with the countries named, but, aside from this fact, it is asserted, it will be in the interest of all the Atlantic cables to send their messages to the East via this Pacific cable, as it is estimated that more than 90 per cent. of the traffic is European. Thus the establishment of an American Pacific cable will attract to it a large traffic which is now diverted to other lines.

Personal.

Mr. E. C. Osborn has been appointed General Manager of the Poughkeepsie & Eastern.

Mr. A. L. Rives, General Superintendent of the Panama Railroad, has resigned.

Mr. Collis Shanks has resigned the position of General Foreman of the South California shops at Los Angeles, Cal.

Mr. W. E. Symons, Master Mechanic of the Atchison, Topeka & Santa Fe, at Raton, New Mexico, has resigned.

Mr. T. S. Inge has been appointed Master Mechanic of the new Burlington (N. C.) shops of the Southern Railway.

Mr. Charles F. Mayer, President of the Baltimore & Ohio Railroad, has resigned.

Mr. J. W. Karner has been appointed General Manager of the St. Louis, Belleville & Southern, with headquarters at St. Louis.

Mr. G. A. Miller, who has been Acting Master Mechanic of the Florida East Coast Railway, has been appointed to the position.

Mr. R. L. Herbert has been appointed Master Mechanic of the Southern Pacific at Victoria, Tex., vice Mr. I. R. Garnott, transferred.

Mr. Albert Griggs, Assistant Superintendent of Motive Power of the Chicago & Eastern Illinois Railroad, has resigned and the position has been abolished.

Mr. C. E. Schaff, Assistant General Manager of the Cleveland, Cincinnati, Chicago & St. Louis Railroad, has been appointed General Manager of the same.

Mr. George B. Roberts, President of the Pennsylvania Railroad, was on December 12 chosen Permanent Chairman of the Board of Control of the Joint Traffic Association.

Mr. A. D. Allibone has been appointed Purchasing Agent of the Wisconsin Central, with headquarters at Milwaukee, Wis., to take effect January 1, in place of Mr. J. A. Whaling, resigned.

Mr. J. R. Lane has been appointed Superintendent of the Macon & Birmingham, in charge of transportation, roadway and machinery department, with headquarters at Macon, Ga.

Mr. I. W. Fowle, who has been Master Mechanic of the first district of the Cincinnati, New Orleans & Texas Pacific, at Somerset, Ky., for about three years, has resigned to engage in other business.

The death of Mrs. Emiline Westinghouse has been announced. She was the mother of George Westinghouse, Jr., and H. H. Westinghouse. Mrs. Westinghouse was 86 years old.

Mr. W. C. Peterson has been appointed Foreman of the motive power and car departments of the International & Great Northern Railway, with headquarters at San Antonio, Tex.

Mr. B. P. Bryan has been appointed General Manager of the Terminal Railroad Association of St. Louis, succeeding Mr. Joseph Ramsey, Jr., who has become General Manager of the Wabash Railroad.

Mr. Philip Campbell, General Manager of the Birmingham, Sheffield & Tennessee River road in Northern Alabama, has resigned. His successor is Mr. Samuel Hunt, General Manager of the Cincinnati, Portsmouth and Virginia.

Mr. T. W. Adams, formerly foreman of car repairs of the Boston shops of the Boston & Albany Railroad, and a son of Mr. F. D. Adams, of that road, has been appointed Master Car Builder of the New England Railroad, with headquarters at Norwood, Mass.

Mr. E. H. Talbot has been appointed the Eastern representative of the *Railway Age* and *Northwestern Railroader*. He will be assisted by Mr. W. C. Ford, who for three years has represented the paper in the East. Mr. Talbot was the founder of the *Railway Age*, and was its President for 15 years.

Mr. Patrick Sterling, Locomotive Superintendent of the Great Northern Railway of England, died at Doncaster, England, November 11, aged 75 years. The vacancy has been filled by the appointment of Mr. H. A. Ivatt, formerly Locomotive Engineer of the Great Southern & Western Railway of England.

Mr Richard Durborow has been promoted to be Master Mechanic of the West Philadelphia shops of the Pennsylvania, vice M. Garrett, retired, and R. H. Garland has been promoted from General Car Inspector, with headquarters at Altoona, to be Assistant General Foreman of the West Philadelphia shops, succeeding Mr. Durborow.

Mr. P. H. Schreiber, who has been Master Mechanic of the second district of the Cincinnati, New Orleans & Texas Pacific for the past six years at Chattanooga, Tenn., has had his jurisdiction extended over the entire Chattanooga division, with charge of the Somerset shops in connection with those at Chattanooga. His headquarters will be at Chattanooga, as heretofore.

Mr. William Apps, formerly Master Car Builder of the Illinois Central, has been appointed General Master Car Builder of the Canadian Pacific at Montreal. He succeeds Mr. John Higginson, who recently resigned. Mr. Apps was formerly in charge of the car department of the Great Northern. He was afterward Master Car Builder of the Western of Alabama, and has also been with the Chicago & Eastern Illinois, and the Illinois Central.

On Jan. 1st Mr. Chas. M. Hays assumes the duties of General Manager of the Grand Trunk Railway, to which position he was appointed some months ago, succeeding Mr. L. J. Seargeant, who retires from the management of the road to act in an advisory capacity to the Board of Directors in London. Mr. Hays is an able manager, and his friends expect that he will make a record on the Grand Trunk which will be creditable to himself and exceedingly satisfactory to the owners and patrons of the road.

Mr. William F. Merrill, General Manager of the Chicago, Burlington & Quincy Railroad, has resigned to become Second Vice-President of the Erie Railway in charge of the operating department. Mr. Merrill has been General Manager of the C., B. & Q. since 1890, succeeding Mr. E. P. Ripley. He was born in 1842, at Montague, Mass., and began railroad service in 1866, and was employed as a civil engineer on several Western roads until 1880, when he became a Division Superintendent on the Wabash. Two years later he went to the Chicago & Alton as General Superintendent, and a year later he became Superintendent of the Iowa lines of the C., B. & Q., and four years later General Manager of the Hannibal & St. Joseph and the Kansas City, St. Joseph & Council Bluffs railroads, which form a part of the Burlington system. He occupied this position until he was promoted in 1890 to be General Manager of the C., B. & Q. proper. It is announced that he is to be succeeded by Mr. W. C. Brown, who has been General Manager of the H. & St. J. and the K. C., St. J. & C. B. roads since 1890.

The Greatest Auction Sale.

The world's greatest auction sale occurred at Topeka, Kan., on December 10, when the vast property of the Atchison, Topeka & Santa Fe Railroad Company was sold to Messrs. Edward King, Charles C. Beaman and Victor Morawetz, representatives of the Reorganization Committee. The reading of the notice of sale occupied 30 minutes. This done, Judge Johnson said that, in pursuance of the notice of sale just read, he offered the property to the highest bidder.

"What am I offered?" the auctioneer asked.

"I offer $60,000,000," said Edward King, in a low voice.

"Do I hear any more bids?" cried Judge Johnson. "Once twice, the last call. The property is sold to Edward King, Charles C. Beaman and Victor Morawetz."

This ended the greatest auction sale ever known, and the crowd dispersed to the Federal Building, where Judge Caldwell held a session of court to confirm the sale.

As indicating the immensity of the sale it may be stated that the system proper embraces 4,670 miles of railroad, on which are now being used 864 locomotives, 28,187 freight cars, and 584 passenger cars. The system has practically been built within the past twenty years, the extension into Chicago being only about seven years old. Originally the line was intended to parallel the old Santa Fe trail, over which was transported the greater part of the commerce of the plains. Over 100 days were required to reach Santa Fe by freighters over this historic trail, the same route now being covered in twenty-eight hours by the road's overland trains. This commerce of the plains grew to such proportions that in 1858 there were on the trail 2,500 men in some way engaged in this traffic. In that year there were registered at Council Grove, Kan., 1,827 wagons, 429 horses, 5,316 mules, 15,714 oxen, and 67 carriages or passenger vehicles. During that year there were 9,608 tons of freight carried over the route, equal to about 500 carloads. There was over $2,500,000 directly invested in this business, with another $1,000,000 as an incidental investment. The trail started from Fort Leavenworth and from Independence Landing, formed a junction just below Lawrence, struck the Arkansas near where Great Bend is now situated, following the river 100 miles crossed and passed through the sandy country for about 60 miles to the Cimarron, which stream it followed to near the southwest corner of Kansas, thence in a general southwesterly direction to Sante Fe, 780 miles from Independence Landing. The present line of the Santa Fe follows practically the same route of the trail. Great opposition was made by the freighters to the building of the line.

The history of the management of the company since it was first organized has been a most varied one, and so many bright railroad officials have stepped to its head with great reputations as managers and had to retire beaten and oftentimes with discredit to themselves that the road has come to be known in railroad circles as a "man killer." In President E. P. Ripley, however, and Vice-Presidents D. B. Robinson and Paul Morton, an exceedingly able group of practical and progressive railroad men is now placed in control of this largest railroad in the world, and it is the confident expectation of those who know their ability and the resources of the road that the troubles of this great company are near an end.

Burglar Proof Express Cars.

A good deal has been said of late regarding the construction of so-called burglar-proof express cars for service on some of the railroads. The reports were to the effect that these new cars were to be made of steel with no windows or doors, or end platforms, and that they would be "collision proof." The President of the Adams Express Company, Col. L. C. Weir, in talking of the matter recently, said:

"It is all nonsense. We have cars equipped with burglar-proof and fireproof safes. These are strapped to the floor of the car, and they are as smooth as a baby's cheek. There isn't a crack where train robbers could possibly insert powder. When a train is attacked, and the robbers place a revolver under the nose of the messenger, he simply tells them: 'All right, boys, help yourselves. There is the safe; I can't open it.' And that stumps them. Whenever a robbery is reported, we are deluged with letters from all sorts of cranks and inventors over the country, each one of whom has a patent that is the only preventive. Only a short time time ago we had one letter from a chap who wished us to keep what he had to offer an inviolable secret. He said that he had not patented it, and was only waiting to hear from us. His plan called for the construction under the roof of the car of a chamber with falling doors. As soon as the robbers entered the car, all the messenger had to do was to throw a switch. This let down the doors of the concealed chamber. As soon as the doors fell, a blast of air was created from some mysterious source, and countless numbers of little balls of India ink would be thrown into the car, branding every man jack of the robbers indelibly for future identification, to say nothing of scaring them to death.

"Another chap I remember had a scheme that was unique. It consisted of the placing of a cylinder in the car. The moment the messenger appreciated that he was attacked all he had to do was to drag the safes into the cylinder and lock them up there alone with himself. The cylinder was punctured with holes, which commanded every part of the car, and through them he could shoot the robbers down one by one. When we asked him what was the matter with the robbers shooting back through these same holes and punctoring the messenger, he was stumped and retired. On some of the Western roads they are now trying a new plan. Each express car is equipped with one or more cylinders of small diameter, which are filled with a powerful chemical preparation. The instant the messenger inside has reason to think that his car is threatened he takes the cylinder down from its case and drops it through a prepared opening in the floor of his car. Then, by a pressure of the foot or some other simple method, he ignites the thing. The chemicals flame out and illuminate the country for a great distance around. The cylinder becomes a great torch. The experiment is being tried there, but whether it will be a success or not remains to be seen.

So far as this company is concerned, there is not at the present time a single man out of durance vile who ever robbed the company; that is, unless his term has expired. This is true from the days of the Reno gang, and that was more than 30 years ago. It costs money to round them up, but we never let up in the search."

The Car Builders' Demand.

One of the most marked features of the lumber trade this year has been the steady, large and imperative demand from railroad companies and car shops for car building material. The panic of 1893 and the resulting depression in general business largely stopped the requirement for car and other railroad material. About the only buyers were roads in the hands of receivers, which were able to devote part of the earnings to the maintenance of way which supposed-to-be solvent roads devoted to the paying of interest. The result was that a year ago and in a more marked degree in 1894 side tracks and freight yards were encumbered with disabled equipment which was not immediately needed, and for the repair of which there were no available or appropriated funds.

In the midst of such a condition of things came a revival in business, a revival which, without much of the boom element in it, nevertheless was substantial and large. Repair work was taken up with vigor, and as the year progressed it was evident that new equipment was needed. Consequently the car shops have been crowded with work both on repairs and new construction, with a marked influence on the lumber trade.

The remark has been made that the salvation of the lumberman of Georgia has been the demand for car material. The fir manufacturers of Oregon and Washington have largely benefitted, and in every line of the lumber trade the freight car requirement has given business and profit. This has been so even in the white pine trade and is one of the most cheerful features of the winter season, for the car demand has not yet abated in any marked degree.

In the wholesale markets like Chicago, the quietude of later December and early January is enlivened by an overhauling of the yards in getting out car lining and other similar stock. A common board or strip may have at one end four or five feet which is just what the car builder wants; and when otherwise the yard crews have little to do, they are taking down piles and remanufacturing the lumber in them so as to get better results in the aggregate than could otherwise be the case. The 175,000 miles of railroad in the United States with their requirement for ties, bridges, fencing, stations and cars furnish a no inconsiderable proportion of the lumber requirement of the country.—*The Timberman.*

The Most Advantageous Dimensions for Locomotive Exhaust-pipes and Smoke-stacks

BY INSPECTOR TROSKE.

[Previous to the consolidation of the NATIONAL CAR AND LOCOMOTIVE BUILDER with the AMERICAN ENGINEER AND RAILROAD JOURNAL three portions of a translation of Herr Troske's very valuable paper, were published in the last-named journal. If succeeding portions were continued seriatum in the new publication, the readers of the NATIONAL CAR AND LOCOMOTIVE BUILDER would have been without these first parts. It has, therefore, been thought best to re publish them in the consolidated journal.]

It is well known that the efficiency of a locomotive depends more upon the steaming qualities of its boiler than it does upon the proper dimensions being given to its principal parts and the adhesive weight that may be upon its wheels, and that this steaming quality is, in turn, dependent upon the combustion taking place upon the grate, and that this is finally dependent upon the strength of the draft. If this latter is too weak, the fire burns sluggishly and the steam production is low; while, on the other hand, if it is too strong there will be many pieces of unburned coal drawn through the flues, which will accumulate in the smokebox as cinders, oftentimes even blocking up that space, or a portion will be thrown out of the stack as sparks; either case serving to increase the coal consumption unnecessarily. The draft may even be so violent, as a result of improper dimensions being given to the exhaust-pipe and the smoke stack, that in many locomotives it will be found that the fire no longer rests quietly upon the grates, but dances up and down upon them; which not only has the evil effect of increasing the consumption of coal by a very appreciable amount, but admits more cold air through the air spaces into the firebox than is actually needed for maintaining combustion. This excess of air lowers the temperature in the fire-box and the tubes, and as a consequence injures the production of steam. By contracting or enlarging the mouth of the exhaust-pipe, we know that we can easily increase or weaken the draft, but there are well-defined limits in both of these directions. Contraction goes hand in hand with an injurious back pressure upon the piston, resulting in just so much work lost by the locomotive; while an increase in the diameter of the pipe causes a lessening of the vacuum in the smokebox and firebox, so that finally the equalizing reserve action of the exhaust disappears, and the four exhausts for each revolution of the driving wheels are always sharply defined from each other, the steam, instead, as is the case when running at high speeds, of approaching continuity, now issues from the stack under separate impulses, and thus no longer acts uniformly upon the fire, but in a jerky manner. These are, therefore, the outlying limits to good and economical consumption of coal.

Furthermore, we are dependent, not only upon the proper size of the exhaust nozzle, but also upon its position below the bottom of the stack opening, and upon the dimensions of the stack itself—that is, upon its diameter, height, and position. These four dimensions have no less influence upon the action of the fire and the generation of steam than the exhaust nozzle itself. As with the exhaust nozzle, so by enlarging or diminishing the size of the stack, the draft may be lessened or increased, also by shortening or lengthening the same and finally by raising or lowering the exhaust nozzle with reference to the stack.

HISTORICAL SKETCH.

Soon after the construction of the first railway, experiments were instituted for the purpose of locating the exhaus nozzle in the most efficient position, and it is well known that Stephenson owes his victory in the locomotive contest at Rainhill, in 1829, to the fact that he was the first to make an application of the exhaust nozzles to boilers for inducing a greater draft. Pambour, in 1836, was the first to institute a systematic series of experiments. He made, however, only a few, and the results that he obtained are of no great value. Nevertheless Pambour set forth the proposition that the exhaust-pipe pressure varies directly as the speed of the piston and the generation of steam per hour, and, therefore, inversely to the sectional area of the pipe itself. He considered that the pressure in the exhaust-pipe was the same as the back pressure upon the pistons, until, in 1847, it was proven by Gouin and Le Chatelier that this is not the case. Among the French engineers who busied themselves with this question at that time was Polonceau. He made some special experiments with exhaust nozzles of various sizes.

Clark first threw light on these subtle relationships by means of his very important and thorough investigations which were made in 1850. They were made upon a large number of locomotives, and from them the following results were obtained:

1. The vacuum in the smoke-box stands in direct relationship to the pressure in the exhaust-pipe. That is, the vacuum expressed in inches of a water column gives the pressure in the exhaust-pipe in inches of mercury:

$$\frac{\text{Vacuum in smoke-box}}{\text{pressure in exhaust-pipe}} = \frac{1}{13.6}$$

or, in round numbers, $\frac{1}{14}$.

2. The draft creating properties of the exhaust is, first of all, dependent upon the form and size of the stack and the position of the nozzle. Above does the height of the exhaust opening and the diameter of the stack influence this matter.

3. With each stack there is some maximum size of exhaust nozzle that will produce the best results. For a given boiler there is only one diameter of stack that is most efficient; and for all other diameters the nozzle must be contracted

4. The best position for the exhaust nozzle is that from which the steam will be blown vertically into the stack. Hence the center line of the nozzle must coincide exactly with that of the stack.

5. The products of combustion must be able to enter the stack easily, either by making the bottom bell-shaped, or, better still, by locating the exhaust opening below the top of the smokebox by about the diameter of the stack.

The exhaust will thus be always blown through and through the products of combustion, and not merely over the top of the same. A straight, vertical exhaust pipe is therefore greatly to be preferred to the crooked pipe that was formerly in general use, since it offers less resistance to the steam as well as to the gases in their passage to the stack.

6. The proper sectional area of the exhaust nozzle is dependent upon the grate area, the sectional area of the tubes, the diameter of the stack, and the size of the smokebox.

The larger grate area and the sectional area of the tubes in the firebox tube-sheet, and the smaller the diameter of the stack and the size of the smokebox, the larger it is possible to make the nozzle.

7. In order that a stack may work at its maximum efficiency, it must have a length that is approximately about four times its diameter.

8. The smallest sectional area of stack that was observed was one-fifteenth of the grate area, and this permitted the use of a larger exhaust nozzle than any other larger stack. So that these observations are taken to indicate that this proportion (one-fifteenth) is the most efficient.

9. The exhaust nozzle may have a sectional area equal to from one-sixty-sixth to one-ninetieth of the grate area, provided that the sectional area of the tubes in the firebox tube-sheet shall be made from one-fifth to one-tenth of the grate area.

10. The vacuum in the firebox is from one-third to one-half of that in the smokebox.

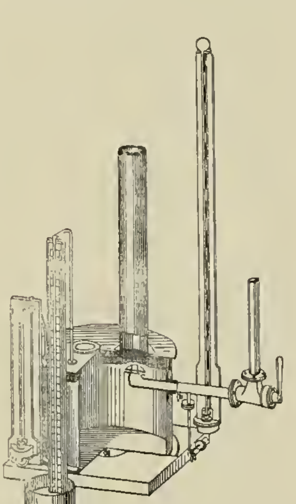


FIG. 1

[THE ZEUNER APPARATUS.

It should be remarked just here that the English locomotives of those days had very small grates, whose area did not average more than 12 square feet; hence, Rules 9 and 10 cannot be applied to locomotives of the present day. Also, Rule 3 and the second paragraph of Rule 6, in which it is stated that the exhaust nozzle can be enlarged as the diameter of the stack is made smaller, cannot be applied in its general construction to locomotives. According to the Hanover experiments, the vacuum can be increased by making the diameter of the stack less. With this, if the original vacuum is to be retained, the nozzle may be enlarged, which will result in the lowering of the pressure in the exhaust-pipe, and the back pressure upon the piston; but, as I stated at the opening of this paper, this enlargement of the nozzle must take place between narrow limits, else the combustion will be poor and the coal consumption increased. For this reason, then, it would be inexpedient to use that small size of stack that would permit the largest nozzle to be used.

Furthermore, my investigations have led me to the belief that it is generally desirable to use as large a stack as possible. Especially worthy of note in the Clark rules that are given above are the results 2 and 5, wherein it is asserted that the height of the nozzle has an important influence upon the action of the fire, a position that is disputed as being incorrect by some later writers. Later, during Peacock's experiments, Clark was Locomotive Superintendent of the Manchester, Sheffield & Lincolnshire Railway, and in the summer of 1850 undertook a series of experiments with locomotives, and found that by lowering the opening of the exhaust-pipe and enlarging the same he could secure a better production of steam.

In the locomotive under consideration, which had a cylindrical stack with a diameter of 16 inches and having originally a nozzle 4¾ inches in diameter that was 1 inch above the top of the smokebox, it was gradually dropped until it was 18 inches below the top of the smokebox, where a nozzle with an opening of 4¾ inches gave the best results. As a result of this experiment Peacock placed all of his nozzles at this distance below the top of the smokebox.

In Germany, Switzerland, and other countries these results seem to have been followed without any change up to the present time.

Zeuner.—Eight years after these experiments, in the summer of 1858, Zeuner began his well known experiments upon the exhaust pipe, which he continued during the following year, and in 1863 published his epoch-making book, "The Locomotive Exhaust-Pipe," and embraced therein his theory of its action.

Zeuner carried on his experiments in the workshops of the Zurich Railway with an especial apparatus. In order to render a comparison possible between the results obtained by various experimenters, who have made use of special apparatus, and determine the value of their deductions, it will be well to give a short description of them.

The Zeuner apparatus is shown in Fig. 1. It consists essentially of a sheet iron chamber having a diameter of 22.44 inches and a height of 17.7 inches, into which the steam-pipe from the boiler projected carrying the blast nozzle at its extremity. Upon the top of this chamber the stack was placed and through it the steam with the air that had been drawn in escaped. Afterward an opening about 4 inches in diameter was made in the top for the purpose of admitting air. The steam pressure in the blast-pipe was regulated by means of a hand-cock and measured by a quicksilver gage, while the vacuum that was induced in the chamber was also measured by a similar gage and a water column.

The stacks, of which there were five, had clear diameters of 1.6 inches, 3.2 inches, 3.9 inches, 4.7 inches and 5.8 inches, while the blast-pipe had diameters of .39 inches and .56 inches.

In the air opening for the purpose of changing its sectional area there were placed rings having clear openings of .39 inch, 7.8 inch, 1.56 inches, 2.26 inches and 3.15 inches inside diameter.

From these investigations, which embraced over 2,000 measured observations with this apparatus and from his theoretical opinions, which were the first upon this subject that were examined in so thorough a manner, Zeuner came to the following conclusions:

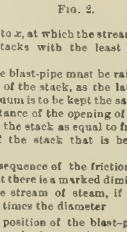


FIG. 2.

1. The distance x, as given in Fig. 2, which is the distance of the top of the nozzle from the bottom of the stack, can be varied between tolerably wide limits, without particularly disturbing the evenness of the ratio of the vacuum existing in the chamber during the outflow of steam.

Nevertheless, he adopted as the result of his investigations 1.57 inches as being the distance equal to x, at which the stream of steam could enter the different stacks with the least hindrance.

2. In general, the opening of the blast-pipe must be raised and brought nearer to the mouth of the stack, as the latter is made smaller, provided the vacuum is to be kept the same. It may be possible to take the distance of the opening of the blast-pipe below the opening into the stack as equal to from one to two times the diameter of the stack that is being used.

3. In general it happens, in consequence of the friction of the steam and air in the stack, that there is a marked diminution of the suction action of the stream of steam, if the length of the pipe is more than 30 times the diameter

4. It was also observed that the position of the blast-pipe relatively to the opening into the stack, the capacity, and, in a general way, the very shape of the smoke-box of a locomotive, and, finally, the height of the stack, have all a very important influence upon the action of the exhaust. At least it may be asserted that locomotives built to-day in accordance with these directions can hardly be improved.

5. The vacuum—that is, the difference existing between the pressure in the chamber and that of the atmosphere—increases in a direct ratio with the steam pressure. It does not depend upon the absolute size of the steam opening, the air opening and the stack, but upon the ratio existing between the first and the last, and the quotient:

$$\frac{\text{Area of steam opening}}{\text{Sectional area of stack.}}$$

6. For a given size of blast pipe and air opening, there is always some diameter of stack, wherein the sucking action of the steam current is the greatest, and with all other diameters this action is weaker. This point of maximum efficiency leaves one in a position to define the theory of the action very sharply.

7. With the same nozzle opening and stack, the amount of air drawn in varies directly with the square foot of the steam pressure.

8. The ratio existing between the vacuum in the smokebox and the pressure in the exhaust-pipe is variable, and, with the ordinary blast-pipe arrangements, depends essentially upon the cross-section of the blast-pipe opening and a known co-efficient, u, indicating the resistance of the products of combustion in the tubes. If, therefore, we adopt the common acceptation of the results of Clark's experiments, which have been used up to the present time, this ratio becomes one-fourteenth for locomotives, and that only an approximation and applicable, also, only to the locomotives upon which Clark conducted his investigations. On the whole, however, it appears that, when everything has been taken into consideration, this ratio can be subjected to no very great fall, provided the heating and running of the locomotive is normal.

* Translation of a paper read before the German Society of Mechanical Engineers.

It must be remarked just here, however, that the conclusions announced in Nos. 1, 3, 4 and 6 are not in accord with the results of the experiments carried out in the Leinhausen shops in the years from 1892 to 1894. In opposition to Zeuner, it must be said that the position of the exhaust nozzle relatively to the bottom of the stack, as well as the length of the stack, certainly does have an influence upon the working of the draft. Further, this is evidently not limited to a stack having a length equal to 30 times the diameter, but to one with a length of six diameters. Finally, that diameter of stack which showed the highest vacuum in the apparatus cannot be said to be universally the most efficient, since upon a locomotive it might act very unfavorably. We can see from the data developed by the Hanover experiments that the vacuum rises, the other conditions remaining the same as the stack is made smaller; that is, within certain defined limits and beyond these limits it falls rapidly away. This stack, which in the apparatus gave the best draft, is too small for a locomotive, the ratio between whose grate and tube areas is based upon the dimensions of the experimental apparatus, and, consequently, would not give a proper draft to the fire nor an economical coal consumption, and so cannot be claimed to be the most economical. This brings up still another influence that will be referred to later

That Zeuner reached the other results which he has promulgated depended upon his choice of the dimensions of his apparatus. Not only was the stack altogether too long, but it was far too large in comparison with the diameter of the blast nozzle that was used. The latter had, as we have already said, a diameter of only from .39 inch to .56 inch, while the former was 1.6 inches, 3.2 inches, 3.9 inches, 4.7 inches, and 5.8 inches. Hence, the diameters of these stacks were 4, 8, 10, 12, and 15 times as large as the .39 inch blast nozzle.

Now, in actual locomotive practice, as well as in the recommendations of Zeuner, we have nozzles varying in diameter from 3.5 inches to 5 inches. Suppose we take one with a diameter of 4 inches, we must, in accordance with the data given by this apparatus, have five stacks with diameters of 16 inches, 32 inches, 40 inches, 48 inches, and 60 inches, sizes which naturally are wholly out of the question for practical work. Then, too, the smallest stack of the Zeuner apparatus gave values that varied from those obtained from the other four large ones, yet Zeuner disregarded it in his investigations, although it approached more nearly than any of the others to locomotive practice; and, in addition, the vacuum was very low, giving a water column of only 1⅝ in. with an excess of blast-pipe pressure of ¼ atmosphere, while in actual locomotive service it is at least double this, with a blast-pipe pressure that is considerably lower.

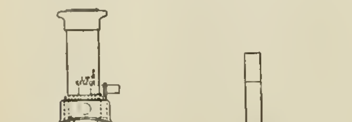


FIG. 3.—THE NOZO AND GEOFFROY APPARATUS.

It is also highly probable that in the further stack experiments air was drawn in from above, as was shown to be the case in the Hanover experiments. From this point of view, also, Zeuner found a very slight difference in the vacuum, whether he conducted his experiments in an open or perfectly tight chamber, and from the same standpoint be found no marked influence due to the length of the stack, although he gradually shortened it from an original length of 4 feet 11 inches to 14⅝ inches. What an important influence this variation in length does have upon the action of the exhaust is evidenced by the Hanover experiments. Although it should happen that not one of the values derived from these experiments should have a practical working value, we still have the service which the genius of Zeuner rendered in developing the theory of the blast-pipe, and for which the painstaking investigations which he carried out were necessary.

Nozo and Geoffroy.—At almost the same time with Zeuner—that is, in the Fall of 1869—the French engineers, Nozo and Geoffroy, carried out some similar experiments, independently of Zeuner, but also with cylindrical stacks only, since up to that time no other shape was known. The apparatus used by them is illustrated in Fig. 3. It was similar to the Zeuner apparatus, yet with this essential difference, that it was not cold air but the products of combustion of a locomotive which were drawn in, and that the boiler of the same supplied the steam for the experiments. The steam was led from the throttle into a special reservoir of 11.3 cubic feet capacity, and in this, while each test was being carried out, a constant pressure was maintained, which could be accomplished by means of the throttle-valve and one on the reservoir opening into a wastepipe. The blast-pipe chamber also had a capacity of 11.3 cubic feet. In the pipe used for conducting the products of combusion into the chamber, an anemometer was placed which could be read through a glass-covered peephole. In order that the experiments might be carried on with openings for the admission of air of different sizes, false plates with holes of the same size, but varying in the number of the same, were placed in the blast chamber in front of the air-pipe. During these experiments the locomotive boiler was fitted with a stack 21 feet 3⅞ inch high, whose natural draft sufficed for the generation of the steam.

The experiments were made with four blast-pipes of .39 inch, .55 inch, .79 inch, and 1 1 inches diameter, and 10 stacks varying in diameter from 1⅝ inches to .79 inch in diameter. The height of the latter was equal to eight times its diameter The perforated plates had a free sectional area through holes of 35 inch diameter that varied in number from 20 to 320 The steam pressure in the receiver varied from 1 to 11⅓ pounds per square inch.

Upon using a blast nozzle having a diameter of 1.6 inches, a stack 5.5 inches in diameter, and a steam pressure of 2 pounds per square inch, a vacuum equivalent to a water column of 1.7 inches would be obtained in the smokebox of the apparatus, while the temperature of the air that had been drawn in would be about 313 degrees Fahr. If the steam pressure was increased threefold to 6 pounds per square inch, a vacuum of 5.555 inches would result, and the temture would rise to 331 degrees Fahr., which was about one-half the true temperature. Nozo and Geoffroy arrived at the following conclusions:

1. Each length of stack that gives the maximum results is independent of both the area of the blast nozzle and the passage for gases, but not of the steam pressure, and is but slightly independent of the diameter of the stack. It must be from six to eight times that diameter. A greater length has no influence.

2. A funnel-shaped opening to the bottom of the stack seems to have no marked influence upon the draft.

3. A stack of suitable length can project down into the smokebox to the top row of tubes without injury to the draft, if the blast nozzle is dropped at the same time; but the draft is very seriously impaired if the lower end of the stack is plunged down into the stream of gases.

4. With a proper length of stack—that is, one varying from six to eight times the diameter—the distance of the nozzle from the stack has no marked influence so long as this distance does not exceed one and one-half times the diameter of the stack; when this is exceeded the draft is materially injured. The projecting of the nozzle into the stack seems to have no detrimental influence worth mentioning, so long as the adjustment of the nozzle is such that it is in true alignment.

5. With a given sectional area of the tubes and nozzle, and a given velocity of flow of the steam, there will be one sectional area of stack that produces the greatest draft, the length being held at from six to eight times the diameter, In the neighborhood of this area the diameter of the stack can be subjected to considerable variation, without having any very great influence upon the amount of air that will be drawn in.

6. If with the same tube area or the same resistance the nozzle be changed from double to single, the result will be according to five, that for a given stack and velocity of steam flow the draft will be increased.

7. An ordinary stack of a given section and a single nozzle can be replaced by a multiple stack and a multiple nozzle—that is to say, a single large nozzle can be replaced by a bundle of small tubes.

To these conclusions it may be remarked that the length of stack as they found it is too great, and is doubtless to be attributed to the small dimensions of the apparatus that was used. The ratio which corresponds to the effective action, as shown by the Hanover experiments, is that, for the maximum draft, the length should be from four to five times the diameter. Furthermore, the funnel-shaped opening does have a very important influence upon the draft, since it offers free access for the gases to the current of steam.

Likewise conclusions 3 and 4 do not coincide with locomotive experience, and the same may be said of the concluding portion of No. 5. As has already been noted, Zeuner says that a stack always maintains the best draft at a given ratio. Conclusion 6 is likewise at fault, for, for each diameter of nozzle there is also only one cylindrical stack that will give the maximum draft, provided the length remains unchanged, whose diameter increases the larger the nozzle that is used with the same steam pressure.

Conclusion 7 is of no practical value for locomotive work.

Nozo and Geoffroy also conducted their experiments upon a running locomotive while it was hauling a train. In this work they used seven different stacks having diameters of 9 inches, 11 inches, 12.5 inches, 14 inches, 15.4 inches, 17.7 inches and 17.8 inches, whose lengths were 6 feet 2.8 inches. The nozzle had a diameter of 4.3 inches, with its opening 3.9 inches below the bottom of the stack, so that the effective height of the stack was 6 feet 6.7 inches.

The results obtained from these experiments were as follows:

The three stacks, with diameters of 9 inches, 11 inches and 17.8 inches, were useless, while with the other four the trip could be readily made on schedule time. The stacks with diameters of 12.5 inches, 14 inches and 15.4 inches diameter, gave a plentiful supply of steam. A graphical result was drawn for each stack, and these showed that the diameter of 14 inches was the best for the locomotive under consideration.

Regarding these experiments, it may be said that the action of the stack appears to be judged entirely by the amount of draft obtained; but this construction is not the only one that should have an influence, for, in Germany at least, it is required of the stack that the fire shall not only work properly and burn quietly, but that the amount of coal that is carried from the firebox to the smokebox shall be as small as possible, thus cutting down the amount of sparks and cinders. It seems odd, too, to note in this report that with a stack of 17.7 inches diameter the trip was made on schedule time, while with a stack of 17.8 inches in diameter, or only .1 inch larger, the action was unsatisfactory. Here, at all events, there must have been some other circumstances at work which could not have been known to the observers, so that the experiments of Nozo and Geoffroy are of little value for the construction and operation of locomotives of the present day.

Prusmann: A later experimenter in this matter, Prusmann, the inventor of the conical smokestack that has been named after him, must be mentioned. He began his experiments about the end of the year 1860, which was at about the same time as those conducted by Nozo and Geoffroy, but he went into the work so extensively, that they were not completed until the beginning of 1863. His paper was published in the *Organ fur die Fortschritte des Eisenbahnwesens* in 1865, and in the same year it also appeared in book form, where he gathered together his extensive results that had been reached with so much labor.

In Figs. 4, 5 and 8 the experimental apparatus that was used by Prusmann is shown. Fig. 4 shows the first arrangement that was used. It consists of a cylindrical box only 3.28 inches in diameter, through whose cover the cylindrical stacks having the same outside but varying inside diameters could be slipped and then held in any desired position by a set screw. The blast-pipe entered through the bottom, and was connected with the boiler by means of a pipe in which a cut-off cock was placed. The opening of this cock could be

Fig 4.

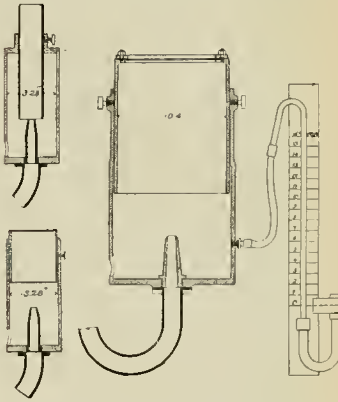


Fig 5. Fig 8

made anything that was desired by means of a handle fastened to its square stem and moving over a graduated arc, thus permitting of an exact regulation of the blast-pipe pressure. Directly over the bottom of the box, as shown at the left in Fig. 4, there was an opening 1⅛ inches in diameter, through which the air was drawn in by the suction created in the interior. The vacuum was measured by a water column in the form of a siphon shaped glass tube, whose connection with the box was packed with a rubber washer, the exact blast-pipe pressure not being obtained, but merely that existing in the boiler, while the experiments were in progress, which was read on a metallic pressure gage. In his experiments Prusmann chose only such openings of the cock on the apparatus as would produce a vacuum equal to that prevailing at that time in the current practice on the locomotives of the Hanoverian State Railway—namely, from 6 to 7 inches, which was obtained by placing a stack on the experimental apparatus corresponding to that in use upon these locomotives. The nozzle of the blast-pipe had a clear diameter of 0.32 inch, and the seven cylindrical experimental stacks had diameters of about 1.25 inches, 1.33 inches, 1.5 inches, 1.58 inches, 2.125 inches, 1.7 inches and 1.77 inches.

Prusmann formulated the following conclusions as the result of his experiments:

1. The blast-pipe pressure within the limit of current practice has no influence in determining the proper shape of the stack.

2. The increase of the distance from the bottom of the stack to the top of the blast nozzle is not exactly an equivalent, but as it is increased, of course within certain limits, it is accompanied by a corresponding increase in the height of the vacuum.

3. Of the seven experimental stacks used, the one of the mean diameter of 1.58 inches showed the best results.

4. With a stack of the most efficient diameter, its height should be so adjusted that it stands at least four times the diameter of the blast-pipe above it, in order that this latter may be at a proper distance from the lower end of the stack.

5. For every height above the blast nozzle there is one cross-section of stack that will give the most efficient working

In order to investigate these latter results which he had obtained, Prusmann changed his experimental apparatus so that he replaced the solid cover by a movable open shell, like that shown in Fig. 5, that could be fastened in position, and on the upper end of which plates having circular openings of different sizes could be bolted. The diameter of the openings in these plates varied by one-eighth inch from 1 inch to 2¼ inches. By changing the shell the 11 plates were set at a greater and greater distance from the blast-pipe, varying from 6 to 7.6 inches, and in this way the vacuum was measured for 39 different positions. Prusmann thus obtained 11 series of results with 39 figures in each, which he put together in the form of a table, and in such a way that for each of the 39 positions of the blast-pipe the 11 different vacuums that were obtained formed a horizontal series. In each of the vertical, as well as the horizontal, series there was one of the highest efficiency.

He drew therefrom the following conclusions:

6. For each diameter of opening in the plates there is one distance from the blast-pipe that gives the highest vacuum.

7. The proper form of stack is not a cylinder, but a pipe whose diameter varies with the distance from the blast-pipe.

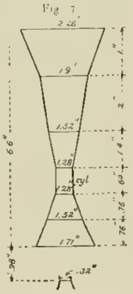
Now when Prusmann had laid out the blast-pipe distances already mentioned upon a vertical axis, and had then drawn parallel lines through these points, he then laid out upon each side of the vertical, the radius of that plate opening which, for the corresponding distance from the blast-pipe, gave the highest vacuum, and thus obtained a series of circular sections, as indicated in Fig 6, that outlined the general average form of a cone, and from which the conical form of stack was deduced.

Prusmann made a stack of this shape out of tin, placed it upon the apparatus, and ascertained, by very careful adjustments, that distance of the lower end of the same from the blast-pipe where the highest vacuum was obtained. He then experimented with several tin stacks of similar shape and finally developed that shown in Fig. 7 as being the form that showed the highest efficiency.

It is worthy of note that a cylindrical section was located in the narrowest portion for the sake of avoiding the sharp angle that would otherwise exist between the top and bottom parts, and thus avoid a too rapid widening above and below.

Fig. 6.

Fig. 7



Prusmann then made a stack for a locomotive of exactly this shape, with dimensions proportioned in the ratio of the blast-pipe dimensions of the locomotive to those of the experimental apparatus, which was $\frac{2.79 \text{ in.}}{0.32 \text{ in.}} = 8.594$. The most contracted portion of this stack had a diameter of 11 inches and stood at a height of 27 inches above the top of the nozzle. The locomotive upon which it was placed, and which had formerly made sufficient steam to do its work with a cylindrical stack having a diameter of 15 inches, was now found to act in such a way that the exhaust nozzle could be opened .28 inch, and an average saving of 23.81 per cent. in the consumption of coal effected, which in some cases arose to as much as 42.2 per cent. On a second locomotive, which had a blast nozzle of about 42.2 per cent. greater diameter, or of 3⅜ inches diameter, and a conical stack of correspondingly larger dimensions, or $\frac{3.375}{0.32} = 10.547$ times larger than those given in Fig. 7, the experiment was a complete failure. "The production of steam was often insufficient, and the coal consumption for the same loads was even increased." From this Prusmann concluded that his method of treatment was a wrong one, in increasing the dimensions of his experimental apparatus in a direct ratio, for it appeared that in the case of the 42.2 per cent. increase in the size of the blast-pipe he had taken it for granted that the grate area had been increased in the same proportion. In order to obtain information upon this point Prusmann built a third and larger apparatus. Fig. 8 illustrates this on a scale of one-tenth its actual size. The larger scale, which was attached to the water-gage, enables more accurate readings to be taken than were possible with the siphon gage. This third apparatus varies from the two others and also from the apparatus of Zeuner and Nozo in that it had three openings arranged concentrically with the blast-pipe, through which the air that was drawn in entered, and which favored the production of the vacuum. The size of these three openings was ascertained from a locomotive whose wheels and pistons were blocked. The valve was raised and so arranged that with the throttle wide open only so much steam could escape through the blast-pipe by way of the contracted openings in the valve passages, that with the ash-pan damper open, as it usually was while running, a vacuum of 0.8 inches of water was obtained in the smokebox. Then the ashpan damper was quickly closed tight, the tube openings into the smokebox closed as tight as possible with sheet iron, and an air damper in the smokebox door opened until a vacuum of 0.8 inches was again obtained in the smokebox. This gave, for coal and coke burning, a free opening equal to the total grate area divided by 21. This ratio was incorporated in the apparatus, and a series of experiments made which also included the use of a nozzle of ¾ inch and one of 1 inch in diameter, with which the height of the stack opening above the same varied from 4½ inches to 25 inches. The results obtained were again tested in part with the small experimental stacks, and led to the following conclusions:

8. Making the conicity of the blast-pipe more blunt has a tendency to lower the stack, but, on the other hand, the conicity of the blast-pipe is without any influence upon the distance of the smallest portion of the stack above the nozzle, or upon the diameter of that portion.

9. Under the same circumstances the taper of the shells of stacks remain nearly the same for all locomotives in similar service, provided only that the ratio of the cross-section of the blast-pipe to the grate area remains the same.

10. A stack made for a given blast-pipe must, if all the other ratios remain the same, be enlarged over all by about the difference in the blast-pipe diameters, if we wish to use a larger blast-pipe with this same taper.

11. On non-condensing locomotives, whereon it is desired to increase the diameter of the blast-pipe, if the blast-pipe pressure remains the same, the distance of the smallest portion of the stack from the top of the nozzle will be unchanged.

12. The upper portion of the smokestack lying above the smallest portion of the same does not consist of a single truncated cone, but of three truncated cones of different inclinations, these inclinations becoming greater toward the top.

Finally, Prusmann gave a number of formulæ for calculating the dimensions of stacks and blast-pipes. The one for the location of the blast nozzle taken as t for all locomotives is:

$$t = 2.3673 + 0.857,047,767\ \delta - 0.136,138,202\ \delta^2 + 0.525,258,551\ \delta^3,$$

wherein δ is the diameter of the blast nozzle in inches.

It may, however, be remarked that, though these experiments were carried out so thoroughly and with so much trouble (for in all Prusmann used 18 different stacks on his apparatus, two of which were similar to those used upon locomotives, and 26 different plate openings) they are not entirely free from objections. Next the dimensions of the experimental apparatus were altogether too small, while the method of measuring the steam pressure was defective. In the first place, the boiler pressure should not have been measured, since it is always liable to a continual shrinkage; secondly, the boiler used had to supply steam for the shop engine of the works, and then these measurements should not have been taken with a metallic gage, since it was evidently far from being sensitive enough for a current of steam flowing through an opening of 0.3 inch. A quicksilver gage should have been used in this place, by means of which an accurate measurement could have been made of the pressure existing between the blast nozzle and the controlling cock. By moving the long handle attached to the cock, it would have been easy to have held this pressure at one point. It is to the imperfection of these measurements that we must ascribe the fact that, from the various tables of figures given by Prusmann, no accurate diagram of exactly what took place can be reproduced; for if we make a graphic delineation of the values given for a series of experiments, we get in most cases not a regular curve, but a broken line, between whose several parts there are wide variations of direction, and this is especially the case if we refer to Tables I., III., V., XII. and XVII. of Prusmann's work. In the last-named table there are, in several instances, two different values for the vacuum produced by the same position of nozzle, which is evidently impossible if the steam pressure remains the same; but before all others in inaccuracy is the statement that that plate opening which, with a given position of the nozzle, gave the best vacuum is the most efficient. This is seen, as a glance at the table teaches, in that the shortest distance is an accompaniment of the smallest opening, while the greatest distance between nozzle and plate is the one belonging to the next to the smallest opening. From which the stack indicated therefrom would evidently be too small. With the stack thus obtained Prusmann experimented still further, and deduced therefrom each location of blast nozzle from the smallest section of stack under consideration, at which the highest vacuum could be produced. This distance be now took as that at which the highest efficiency could be obtained, and transferred it into terms of the ratio of the diameters of exhaust nozzles upon locomotives; but such a performance is not at all permissible, as the Hanover experiments clearly show, for these nozzle distances having the strongest action come out many times as great on many locomotives. If we were to make an application of the Prusmann formulæ given above to exhaust nozzles of 4 inches or 5 inches in diameter, the distance of these nozzles from the smallest section of the stack would, according to Prusmann, be 37.8 inches for the first and 70 inches for the second, values that are unheard of in practice. That the Prusmann stack is above all things too small has long been known. Grove speaks of this in his well-known "Theory of the Blast-Pipe" (1874), and frankly discusses the reason therefor in "The Impossibility of Establishing the Shape of the Stack by Means of the Passage of a Current of Steam through Openings in Thin Plates," but, as we have stated above, this is not the principal reason for objecting to the results given.

There are, however, some results which Prusmann obtained from his experiments, inaccurate as they were in part and inapplicable as they are to the practice of the present day, which are full of significance for all time, and among them are those that led to the construction and development of the conical stack, which by varying its height above the nozzle within certain limits produces the best vacuum.

Zeuner: A very interesting continuation of the experiments of Prusmann was commenced a year later by Zeuner, and published in 1871 under the title of "On the Action of the Blast Apparatus of Locomotives with Conical Flaring Stacks."

Unfortunately Zeuner had, as he says in writing of this work, no knowledge of the results which the Prusmann experiments had yielded, so that he turned to his earlier experiments with cylindrical stacks that were previously briefly outlined but in other respects the information elicited was that resulting from a purely mathematical calculation. In consequence thereof his theory included, not the conical stack, but the location of the blast nozzle and its influence upon the action of the draft; the length of the stack is also disregarded. He laid down the following principles:

1. For a given diameter of blast-pipe and sectional area through the tubes, there is one most efficient sectional area of stack, measured at the smallest point, with which the maximum draft can be obtained.

2. The vacuum in the smokebox and the inrush of the mixture of air and gases increases as the flare on the upper end of the stack is increased, but a moderate amount of this flare soon gives an action that is perfectly satisfactory.

The conical stack will admit, for the same draft action, of a large exhaust nozzle opening. For the same train speed, therefore, it gives more power to the locomotive than the cylindrical stack, on account of the decrease of back pressure upon the pistons, which thus increases its mean effective working and lessens the fuel consumption in consequence.

In its general significance, conclusion No. 1 is not applicable to locomotives; the same thing may be said here that was remarked above relative to cylindrical stacks.

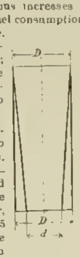


Fig. 10.

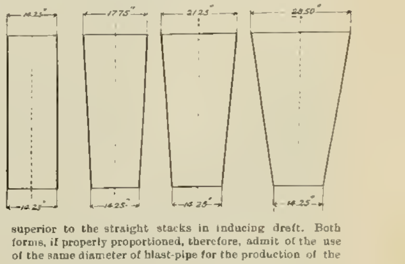
Fig. 11.

The results of the Hanover experiments are also at variance with the statement of No. 2. Zeuner reconciled his theories off-hand by taking a blast nozzle 3.94 inches in diameter, a cylindrical stack of 14.25 inches, diameter with three conical stacks, as shown in Fig. 9, all of whose smallest diameters were also 14.25 inches, while the upper diameters were 17.75 inches, 21.25 inches, and 28.5 inches. He then calculated that the stack with the widest flare—that is, the one with the upper diameter of 28.5 inches—would draw in the most air with a given amount of steam, the blast nozzle remaining the same, and that it is also the most efficient.

The Hanover experiments, on the other hand, showed that if the upper diameter of all stacks is kept the same, while the lower diameter is varied, the strongest draft and consequently the greatest inflow of air will be obtained with that having the smallest diameter. If we start, as Zeuner did, with equal lower diameters, we find from tables X and XII, that give a graphical representation of the Hanover experiments, the very reverse to be the case to what Zeuner theoretically maintained.

The third of the Zeuner conclusions that we mentioned above is also not in accord with more recent experiments, for; as I shall show later on, the conical stacks are not superior to the straight stacks in inducing draft. Both forms, if properly proportioned, therefore, admit of the use of the same diameter of blast-pipe for the production of the same vacuum.

Fig 9



Grove: We come now to the mention of Grove as the last to pursue this line of investigation. In a handbook compiled by Heusinger von Waldegg on special railroad technical work, he has handled the difficult question of the blast-pipe in a very lucid manner, has advanced some excellent theories, especially with reference to the position of the blast-nozzle with reference both to cylindrical and conical stacks. His formulæ are especially valuable for locomotives with small grate areas, but for those having larger areas the calculated dimensions are too small.

In his theory Grove followed in the footsteps of Zeuner relative to the action of the draft, and also advocated the superiority of the conical stack. In paragraph X, that has been already referred to, this comparison is pointed out off-hand, and that in connection with the sectional area of the tubes and not of the grate area, whereby the error is called forth. The tradition regarding the superiority of the conical stack is referable to Prusmann. He compared a cylindrical stack, which was evidently too large with reference to the blast nozzle, as shown in Fig 11, with a conical one whose dimensions were too small. The former had a diameter of 15 inches, and the latter was 11 inches at the waist. The result was that, with the first, the blast nozzle was flush with the bottom of the stack, while, with the conical stack, it was placed 27 inches below that point. Had Prusmann contracted the cylindrical stack correspondingly and then lowered the blast-pipe, he would doubtless have obtained the same improvement in the action of the draft on his locomotive as he did obtain by the application of his small conical stack.

This demonstration of the equality of the two forms of stacks is one of the important achievements of the Hanover experiments.

(To be Continued.)

The largest man in the world is on exhibition in Paris. He is 6 feet ⅞ inch tall, and weighs 520 pounds. His upper thigh measures 4 feet 1 inch around; his calves measure 2 feet 11 inches, and his upper arm is 1 foot 11 inches around. He measures 7 feet 4½ inches around the waist. He is a French-Swiss.

Prospects of Electric Motive Power on the Illinois Central.

In an interview concerning the recent reports of the Illinois Central Railroad and its intention of adopting electric motive power for suburban traffic, the following statements were made by Mr. J. F. Wallace, Chief Engineer of the road.

"In 1891-92 I made an extensive examination into the advisability of adopting electric power for the fast world's fair trains, and with a view to adopting the electric system, if any should be established, for the movement of suburban trains after the Exposition. The result of this investigation was that I reported to my superior officers against the adoption of electricity as motive power. The question has not been officially considered by the officers of this company since 1892, although the progress of electrical invention has been carefully watched and I have personally on my own responsibility, as a matter of engineering interest, been following the advances made towards electric traction for heavy suburban railroad service. I have frequently said I had no doubt that some time in the near future the Illinois Central would take up and consider this question and that conditions were gradually shaping themselves which would make this application possible, not, however, from any preconceived plans for the adoption of electric motive power, but from the fact that the requirements of the service made the conditions more favorable for taking this step.

"I do not think the overhead trolley system will give satisfaction, neither do I consider the third rail system feasible on account of the large number of trackmen working on the terminal and the numerous trespassers crossing and recrossing the tracks. The application of electricity to a service like that of the Illinois Central will necessarily be gradual and slow, and any system that may be adopted should be such as would permit of the common use of the tracks by steam power as well. In other words, the question of the application of electricity on this road is still in the air and while current events indicate that the application will be made in the near future, it may be two, three or five years before the question is even seriously considered.

"Inside of certain limits electricity seems to be the preferable motive power for moving small transportation units at frequent intervals and for short distances; while on the other hand steam is the most economical and preferable for handling large units of transportation at infrequent intervals and over long distances. The line of demarcation between these extremes, is, of course, rapidly changing, and the field for the adoption of electric power is gradually increasing as the appliances therefor are more thoroughly perfected and the problems of economical constructions, maintenance and operation are solved."

An Extraordinary Litigant.

Referring to legal proceedings against the Magnolia Metal Co. in a New York court, the *Commercial Advertiser* recently said:

"The case of The People vs. Shanks will probably make a little history—legal history, but still history. It is pretty difficult to conceive of a man who, without any possible interest himself, will sue a large corporation, go on his own bond in filing an attachment, knowing all the while that he had not a cent in the world, and could not satisfy judgments of many years' standing against him. Yet this is what was developed in the case of The People vs. Shanks. Shanks brought an action last spring against the Magnolia Metal Company on an assigned claim by discharged employees, for $7,000. As the Magnolia Metal Company was a foreign corporation, some one had to qualify as surety in bringing an attachment suit. As a matter of fact, Shanks acted both as plaintiff and bondsman. More extraordinary still, he did so on the advice of counsel, who knew his financial condition, and, to add to the incongruity of the situation, his counsel stated that Shanks had no pecuniary interest in the assigned claim in question.

Col. Alexander S. Bacon, of 34 Wall street, did the probing; Mr. Linus A. Gould and S. Victor Constant, of Constant & Coghill, assumed the responsibilities for the action of his client, Shanks, and Police Judge Kudlich heard the case and couldn't see any particular merit in the plea that the alleged perjury was advised by counsel. Colonel Bacon, the attorney for the Magnolia Metal Company, has for years been attending litigation growing out of suits brought by dummies in the interest of large corporations inimical to the Magnolia Metal Company. The petty annoyances have grown to be intolerable, and the company is invoking the law and is bringing these irresponsible offenders to justice. It is an open question whether a trust is not forming in the anti-friction metal business, and the fact that the Magnolia people have the standard metal which, for about the same price, gives three times the same service, has undoubtedly excited the cupidity of competitors who wish to take over the company's assets and good-will without paying for them.

Mr. C. B. Miller, president of the Magnolia Metal Company, stated in an interview that he had traced discharged employees directly to the offices of the National Lead Company, the Hoyt Metal Company and others. He also stated that his company had brought suit against the Sterlingworth Railway Supply Company for $120,000 damages for breach of contract, under circumstances which bear out the theory of an attempted combination in bearing metal. One of the leading stockholders of the Sterlingworth Railway Supply Company is said to be a prominent official in the Standard Oil Pipe Line.

In spite of considerable persecution, the Magnolia Metal Company has thrived to such an extent that its very metal is now in use in most of the navies and railroads of the world as well as in all classes of mechanical industry. However, the adoption of such methods as are disclosed in the Shanks case and the countenance of them by the members of the bar is a serious menace to all honestly conducted enterprises.

Evaporative Trials of Belleville Boilers.

The London *Times* of Oct. 28, contained a notice of the launch of the *Kherson*, built by Messrs. R. and W. Hawthorn, Leslie & Company, for the Russian Volunteer fleet. This vessel is to be fitted with propelling engines which are to indicate 12,500 horse power on trial, the steam to be supplied by 24 water-tube boilers of the Belleville type placed in three seperate water-tight compartments. The boilers are being constructed by Messrs. Maudslay, Sons & Field, at their works at East Greenwich.

The following account of the trial of these boilers was given in a late number of the *Times*:

For the purpose of the evaporative trials the boilers have been built up where they have been made, the furnace sides and ends being constructed of fire-brick in the same way as if they were *in situ* on shipboard. Although partially under cover, they were practically exposed to the condition and temperature of the external air, which were not very favorable. In the two boilers under trial, each of which consists of eight tube sections or elements, a section containing 20 wrought-iron tubes 4½ inches outside diameter and about 8 feet 6 inches long; the total heating surface is 2,946 square feet and the grate area 93 square feet. As only two boilers were to be tested, a temporary uptake and short funnel were provided, the deficiency in natural draft due to this compulsory arrangement being made up by the application of a steam blast. To insure that all should be in readiness for the official trials, which were to take place on Friday, a preliminary trial of them of six hours' duration was made on the previous Tuesday—the weather being very cold—with results as tabulated below:

Hours of Day.	Coal Burned.	Water Evaporated.	Evaporation per lb. of Coal.	Boiler pressure, lbs. per sq. in.	Blast pressure, lbs. per sq. in.	Coal Burned per sq. ft. of grate.
	Lbs.	Lbs.	Lbs.			Lbs.
11—12 ..	1,848	16,500	8 92	200	20	19.8
12—1 ..	1,747	16,500	9 44	200	23	18 7
1—2 ..	1,512	16,125	10.66	195	23	16 2
2—3 ..	1,747	16,500	9 44	195	23	18.7
3—4 ..	1,792	16,300	9.30	198	23	19.2
4—5...	1,565	17,000	10 84	198	23	16.8

These figures, when run out to their conclusions, give a mean for the whole six hours of the trial of 9.76 pounds of water evaporated per pound of coal consumed, and 18 23 pounds of coal burned on each square foot of fire grate, the mean pressure of the steam being 197.6 pounds per square inch. During the whole of the six hours the mean temperature of the feed water was 64 degrees Fahr.

With these results, the official trials of Nov. 1 (which were to be of 12 consecutive hours' duration) were entered on with confidence. The weather, however, at the start was not propitious, the air being laden with a heavy damp fog. At 5:40 a. m. the fires were lighted, the temperature of the atmosphere being 50 degrees Fahr.; at 6:20 a. m. the steam gages registered 200 pounds pressure in the boilers; and at 6:30 a. m. the measuring of coal and water was commenced, and continued for purposes of adjustment, when it was found that 18 hundred weight of coal was being burned in the hour and the water evaporated 8 8 pounds per pound of coal. At 8 a. m. the official trial was commenced, and continued for the time agreed upon, terminating at 8 p. m. with the following results, deduced in the same way as for the preliminary trial: The average evaporation for the first three hours amounted to 9.2 pounds of water per pound of coal burned; for the first six hours, 9 pounds of water; and for the entire 12 hours, 8.81 pounds of water per pound of coal, the steam pressure being 200 pounds to the square inch throughout; and the temperature of the feed water 64 degrees Fahr. Welsh steam coal of average quality was used during the trial, and the fires were cleaned at the end of the sixth and tenth hours. At the conclusion of the 12 hours trial, an accumulation test was made to ascertain if the safety valves were capable of dealing with any quantity of steam likely to be produced. The valves were accordingly set to lift at 245 pounds' pressure per square inch, and firing was resumed and coal burned at the rate of from 35 pounds to 40 pounds per square foot of grate per hour. The maximum pressure shown by the gages during the hour in which this test was continued was 247 pounds. During the whole of the 12 hours of trial all the coal weighed was fired, and no allowance made for cleaning the fires or for what had fallen through the grates.

As the Belleville type of boiler is now attracting considerable attention, its more extended adoption in naval and commercial vessels being imminent, much interest was manifested in these tests, which were attended by several engineering experts, in addition to the representatives of the builders.

The "Star" power hack saw, made by the Millers Falls Company, of 93 Reade street, New York City, is a time and labor saving machine, that is worth a good deal more than it costs. The machine will cut metal of all sizes up to 4½ inches in diameter. It requires no attention after the work is put in the vise, and stops when the piece is cut off. The quality of the blades used in these machines has been steadily improved, as shown by the fact that one blade recently cut off an inch squre bar of wrought iron 246 times. This could not be done in a hand frame, but in the "Star" power hack saw, where the pressure and stroke are regulated and uniform, one blade will cut steadily for a number of days.

The Root Boilers All Right.

In November last a suit was begun by the Philadelphia Edison Electric Light Company, of Philadelphia, against the Abendroth & Root Manufacturing Company, of New York City, to recover $34,000.00. A countersuit was put in by the Abendroth & Root Manufacturing Company against the Philadelphia Edison Electric Light Company, for $6,830.90. This suit was tried in the United States Court in Brooklyn, before Judge Wheeler and a jury, and a verdict has now been rendered in favor of the Abendroth & Root Manufacturing Company for the amount of the countersuit.

The Abendroth & Root Manufacturing Company are the manufacturers of the well-known Root Water Tube Boiler, and between the years 1889 and 1891 they furnished the Philadelphia Edison Electric Light Company with about 3,500 horse power of boilers, these boilers being supplied on four different contracts, each of which followed the other at short intervals. Soon after these boilers were erected and in operation in the Philadelphia-Edison plant, a series of troubles followed, which finally culminated in a fatal accident. This brought the matter into the Coroner's Court in Philadelphia, where, after a careful investigation by a jury of experts, a verdict was rendered acquitting the Abendroth & Root Manufacturing Company, and holding the Philadelphia Edison Electric Light Company responsible.

The troubles above mentioned were due, as claimed by the Philadelphia Edison Electric Light Company, to bad workmanship, bad material and faulty design, and also due to the contractors failing to comply with all the articles agreed upon in their contract, and on these grounds they brought the suit just closed, in which they sought to recover $34,000, which they claimed they had spent in remedying the so-called defects. The Abendroth & Root Manufacturing Company claimed that the plaintiffs had not paid them all that was due on their orders for boilers, and also for additional material furnished to them, and on these grounds they brought the countersuit mentioned above.

The Abendroth & Root Manufacturing Company succeeded in the first place in establishing the fact that they had lived up to every article of their agreement and had even done more than they had agreed to do. In the second place they succeeded in establishing the fact that they had used the best material obtainable in the market. In this connection it is interesting to note that the greatest number of breaks occurring in these Edison boilers were reported to be in the item of bolts; and as it is a natural conclusion that the greatest breakage will occur at the weakest point, it was necessary to establish by evidence the fact that these bolts were equal, if not superior, to anything to be found in the market. Specimens of the bolts were thoroughly tested and shown to be of the best material. The Abendroth & Root Manufacturing Company also showed by means of photographs the tools which they now use in the manufacture of their boilers, and they showed that the best methods of manufacture were employed in making the boilers for the Edison Company.

The Abendroth & Root Manufacturing Company succeeded in proving that the accidents were due entirely to the handling of the boilers by the Edison Company, with the object of forcing them far beyond their rated capacity, sometimes exceeding this rating by as much as 100 per cent and over. They also showed that the Edison Company employed unskilled labor, and that these employees had instructions to keep steam up to the required pressure irrespective of any demands that might be made on the boilers, and that the whole idea was to keep the lights going which the Edison Company had contracted to supply, without regard to the personal safety of the attendants or capacity of the boilers.

Another very important point established by the evidence was that an excessive forced draft was used in order to drive the boilers to the unreasonable extent to which they were used, and evidence showed that this draft was sufficient at times to support a column of water from three to four inches in height. It was also shown that the feed water used in the boilers was very impure, and that in order to neutralize the effect of these impurities an excessive quantity of chemicals was used with the water.

One of the most interesting points developed was the production of water hammer in the tubes of these boilers, which was explained in the following manner: It is a well-known fact that every pipe or tube has a definite capacity of discharge, and when this capacity is reached no more water or steam can be delivered through an opening of such an area; so that in case a larger discharge is required, a larger tube must be used. In driving these boilers to such an excessive extent, in the course of natural circulation the water and steam passed up along the inclined tubes to the front headers, and there advanced upward into the overhead steam and water drums, from which the steam was delivered to the piping system. When the circulation reached a point equal to the capacity of the tube, of course, no more steam or water could be discharged from that upper end of the tube, but as the heat still continued to be applied around the tube, more steam was generated, and of course the pressure of this steam in the tube forced the steam and water back down the tube until it reached the rear header, and here the steam suddenly had a chance to escape upward by the course of the rear headers to the overhead steam and water drums, and the colder feed and circulating water trying to enter the lower end of the tubes from these same rear headers came in contact with the steam thus seeking passage of escape. The result was a sudden condensing of the steam, which was followed by a rush of water into the vaccuum at an exceedingly high velocity, and this water rushed along the tube at about this same velocity until it reached a bend at the end of the tubes. The result was a very sudden and powerful blow there practically like that of a cannon ball, which caused the bolts to rupture in the manner above described, breaking them. In fact, so rapidly that a flow of the metal composing them at the point of rupture was impossible.

This flow necessarily would take a certain amount of time. The consequences of this sudden blow was exhibited in the breakage of these bolts without contraction of area at the point of rupture. It was remarked during the course of the trial that it was fortunate that these boilers were composed of small headers covered by small castings known as connecting bends, and that thus the damage done affected merely these small castings, producing there local results instead of rupturing large castings, which would, of course, be attended by far more serious ruptures. Glass models were shown at court which illustrated beautifully the theory thus presented, and in such a manner as to carry conviction to the minds of the Court that this was the true theory of the disastrous occurrences. Other glass models illustrated the irresistible power of the water hammer, the force of which was sufficient to break the tubes which held the water surrounded by a vacuum.

The plaintiff brought in as an expert Professor Spangler, of Philadelphia, while the defendant brought in as experts Dr. C. E. Emery, of New York, and Prof. R. C. Carpenter, of Sibley College, Cornell University, Ithaca. Prof. W. D. Marks, of the Philadelphia Edison Company, and Mr. Albert. A. Cary, of the Abendroth & Root Manufacturing Company, also testified as experts on their respective sides.

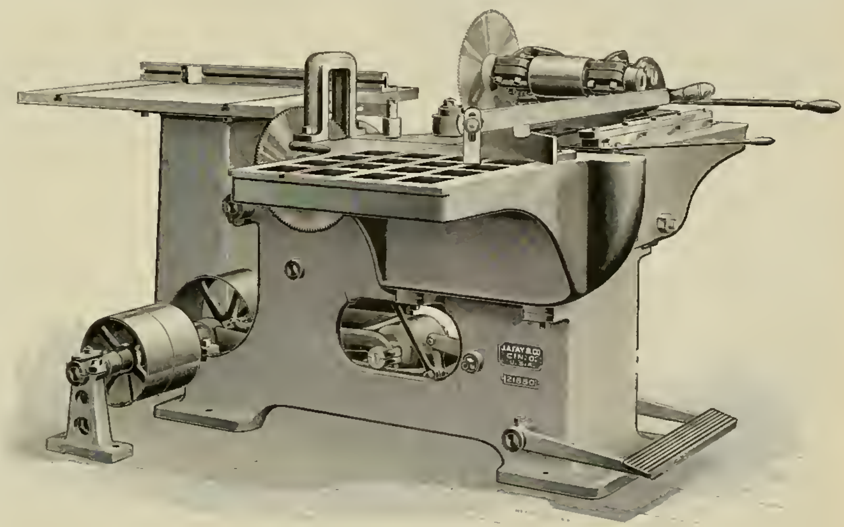
Altogether it is a well-earned and well-deserved victory of the Root Company on which they are to be congratulated.

Improved Car-Brace Cutting-Off Saw.

The use of this machine in any freight-car shop means a saving in time and labor in the cutting of freight-car braces that should command the attention of master mechanics. With it there is no rehandling of the material, no laying out, no preparatory cutting to lengths, no waste material. The angles are cut much more rapidly and accurately.

The framing is substantial; the various shafts and arbors are made of fine steel of proper diameter, and the bearings are long and self-lubricating. The journals are ground true, all joints are planed and the tables are made of iron and adjustments made convenient. The lower saw is mounted in an automatic feeding-carriage controlled by a foot treadle, and with provision for keeping the belt tight. A saw on top of the table at right angles to the lower saw is carried in an adjustable bearing, which allows the saw to be lowered as it is worn down in diameter. It travels in planed ways, securely gibbed to the table, and operated by means of a lever. The table is provided with adjustable fences and guide-rolls. Adjustable stops are added for holding the material against the fences properly.

A supplemental gage table is supplied, mounted on a heavy iron column. This is used for regulating the length of the braces, and is provided with an adjustable fence across the table. This fence is slotted lengthwise, and has an adjustable stop, the right angle cut by the saws having a perfect bearing against the fence and stop. Two saws eighteen inches in diameter are furnished with the machine. Two counter-shafts are provided, each carrying ten by sixteen inch T and L pulleys. This convenient and labor-saving machine is made by Messrs. J. A. Fay & Company, of Cincinnati, Ohio.



IMPROVED CAR-BRACE CUTTING-OFF SAW.

A lead pipe was recently taken up, which, it is related had carried water to a farm house for 74 years.

A Model Train.

Commencing Sunday, Jan. 5, and daily thereafter, the popular New York and Florida Short Line Limited will be resumed between New York and St. Augustine, via Pennsylvania, Southern and Florida Central and Peninsular, leaving New York at 3.20 p. m. The train will be composed of latest improved compartment cars, sleeping, dining, first-class coach and smoking cars, from New York to St. Augustine. For grandeur and solid comfort there is nothing in the world that surpasses this train. The compartment car is a model of perfection. The entire train is most elaborately furnished, and the country through which the train travels is rich in magnificent scenery, and the one day which is consumed in the trip can be spent most advantageously in taking in the beauties of nature. The announcement of the new train several years ago was one of the great achievements of the Southern Railway "Piedmont Air Line," and the public are highly grateful and have and will continue to show their appreciation to the evident satisfaction of those instrumental in reducing the time between New York and Florida to a minimum. Excursion tickets south have been placed on sale at "very low rates," and those contemplating taking a trip to the Sunny Lands should call on or address Mr. R. D. Carpenter, General Agent, 271 Broadway, New York.

The Boies Steel Wheel Company reports business good, and all departments of its extensive works, at Scranton, Pa., running full time. The No. 2 wrought iron center wheel made by this company is winning great favor among the mechanical departments of roads in many sections of the country.

Reduced Quality Follows Reduced Price of Steel Rails.

Mr. J. F. Wallace, Chief Engineer of the Illinois Central R. R., writing in the *Engineering Magazine* for December, says that while it is true that there has been a steady and uniform decrease in the price of steel during the last quarter of a century, the average standard weight of rail for main lines has at the same time increased from 60 lbs. to 90 lbs. per yard, and the quality has materially depreciated. As an example of the deterioration that has taken place in quality, he states that during the past year he has relieved from a main track on tangents rails that weighed 75 lbs. to the yard which had been in the track only five years; whereas, on the same district and under precisely the same traffic conditions, there still remain in the track 60 lb. rails that have been in service for over 15 years, which it was not considered necessary to renew this season. While this may be an exceptional case, he considers the steel rail which was furnished by the manufacturers 15 to 20 years ago about 30 per cent. better than the rail now manufactured. This is not intended to apply to special high class rails, which may be furnished by a few rolling mills under superior specifications, but to the ordinary rail supplied to and purchased by the majority of the railroads in the United States to-day.

A Railroad Struggle Compromised.

The long struggle between the Missouri, Kansas & Texas and the International & Great Northern roads for possession of the Galveston, Houston & Henderson Railroad, between Houston and Galveston, furnishing an outlet on the Gulf, has been terminated in a compromise, after being before the State and Federal courts for about three years. The terms of the compromise as agreed on provide that the M., K. & T. shall transfer to the I. & G. N. 4,999 shares of the capital stock of the G., H. & H. at the par value of $100 a share, being one-half of the total amount of the capital stock of that company, less one share, the "Katy" retaining 4,999 shares, and the two remaining shares being placed with some party agreed upon by both the contending roads in order to secure the strict carrying out of the terms of the agreement. In consideration for this transfer of stock the I. & G. N. surrenders the ninety-nine-year lease made in 1883, by which it secured exclusive possession and control of the G., H. & H. property. The agreement further stipulates that both the International and "Katy" shall enter into a joint contract with the G., H. & H., identical in every detail for the transportation of trains, cars, passengers, tonnage etc., between Houston and Galveston. Under this amicable arrangement the two rival roads will at once begin a joint operation of the G., H. & H. track between Houston and the Gulf, and the "Katy" will be able to touch tidewater.

The evening classes at the Young Men's Institute, 222 Bowery, New York, report a large enrollment this season. One of the most popular classes is that in Steam Engineering. The enrollment in this class includes workers from all fields of the practical applications of steam, viz., firemen, engineers, machinists, etc. They are taught the fundamental principles of the science and also its latest developments. By means of textbooks, lectures and experiments, a comprehensive view is taken of the whole subject. Other subjects taught are the commercial branches, arithmetic, bookkeeping, shorthand, English grammar, and technical branches. Carriage drafting, architectural drawing, mechanical drawing, freehand drawing. Some of these require a two and some a three-year course. A new term will begin Jan. 2, 1896. Young men between the ages of 17 and 35 are allowed to enroll at any time.

Manhattan Elevated Railway Affairs.

According to statements made by the Auditor of the above-named company to a committee of the New York Legislature on Dec. 5, the company has 102 miles of single track. In 1895 the company paid the city of New York $590,243 in taxes, while in 1894 $564,800 was paid. In 1895 the company paid $95,000 to the State of New York in taxes, and in 1894 it paid $93,000. The gross amount of bonds outstanding is now $46,500,000, but $8,500,000 of these will be ordered on Jan. 1. The capital stock at present is only $30,000,000. The gross income for the last fiscal year was $9,397,572; the operating expenses, exclusive of all taxes, were $5,413,964, leaving net earnings at $3,983,608. Then there was an income from other sources amounting to $287,134, which makes gross income $4,270,742. The interest on the funded debt was $2,095,722, the taxes, $652,722, making $2,748,694, which sum deducted from the gross income, leaves a net income to the company of $1,522,048. For the year ending Sept. 30 last the road carried 188,072,845 passengers. The total number of passengers carried since the railway started, up to Sept. 30, is 2,410,845,487. The company has about six thousand employees, and pays engineers $3.50 a day for nine hours' work; firemen, $2; conductors, $2 30, and guards $1.85.

President George J. Gould said, when asked what he thought of building an underground railway: "I think it is possible to build an underground railway, but that it would not pay financially. It is not paying in London, where the circumstances are better than they are here." He said that in his opinion an elevated road with electric motive power would be the best system of transit in New York, and that his company was at present experimenting with electricity. He was asked:

"Have you any complaints coming in about overcrowded cars?" "Yes," he replied, "but I don't see how that can be remedied. In the morning everybody wants to go south and in the evening they want to go north. You can't stem the tide. In Third avenue, during the rush hours, we run trains on 50 seconds' headway, and I don't think they can be run safely on much less headway than that." Mr. Gould also said he was aware that complaints were being made about the lighting of the cars, and they were looking about for a better system. "A year ago we were about to adopt Pintsch gas, but electricity came into prominence and we decided to wait. If we adopted electricity as a power, of course we should want to light cars with it."

"I don't believe in municipal ownership of railways," said Mr. Gould, "and think it would prove disastrous. Government roads are never run so well as roads run by private corporations. They have tried it in Europe with their military roads, and it has proved a failure. The taxpayers have to go into their pockets every time. The Government, I think, should not go into the business."

American locomotives are now going into Europe. The ordering of 40 locomotives by the Russian Government from the Baldwin Locomotive Works, Philadelphia, Pa., leads *La Genie Civile* to say: "Already in the matter of furnishing railroad material American constructors had taken possession of the South American market and were carrying on a formidable competition against the English in their own colonies, especially in New Zealand and Australia, but it was hardly expected that they should be seen obtaining a foothold in Europe." Why not, pray? Are not American locomotives the most beautiful in design, the most nearly perfect in construction, the most reliable in function, the swiftest in motion, and the best in all essentials of all locomotives on earth? Why should European railroad-builders not have as good taste and judgment in selecting locomotives as the railroad-builders of Australia and South America? Go to! Europe, as an artistic country, should buy only American locomotives, or else compel European builders to build locomotives strictly on the American models.—*Iron Industry Gazette.*

The Lake Portable Key-Seater.

The accompanying illustration shows a very useful machine made by the Lake Brothers, of No. 1645 North Tenth street, Philadelphia. As every mechanic knows, in making repairs in shops, etc., it is a very serious thing to be compelled to take down a line shaft, or any part of it, to have a key-seat cut, or if not removed from its position it is necessary to chisel the same, which is a very slow operation, and not very satisfactory when completed. Often a great deal of trouble and annoyance is experienced by having gears, pulleys, couplings and clutches work loose on the shaft when in use, usually the result of an inaccurate key-seat being cut in the shaft. With this machine it is not necessary to remove the shafting from its hangers or boxes to cut a key-seat, and in this way a split pulley or coupling can be applied very quickly, or if a solid pulley is used it is only necessary to remove the hanger or box, so as to slide the pulley on the shaft, thus saving time, which amounts to a great deal where any number of persons are employed.

Our illustration shows the machine as it appears after having cut a key-way 4 inches from the end of shaft. This machine will mill key-seats any length in shafting from $1\frac{1}{2}$ inches to $4\frac{3}{4}$ inches in diameter, and of widths varying from $\frac{1}{8}$ inch to $1\frac{1}{8}$ inches, and any depth not exceeding $\frac{5}{8}$ inch. Each machine is furnished with six milling cutters, which by placing one or more on the spindle of the machine, key-seats the sizes mentioned above, any of which can be cut at one operation the width required. When the cutters are kept sharp the machine will mill all key-seats up to $\frac{3}{4}$ inch wide, by $\frac{5}{8}$ inch deep at one operation, but for the wider key-seats it will be necessary to go over the work two or more times, according to the depth required. The machine is provided with either automatic or hand feed while cutting, and has a dial to show the depth of cut in the shaft. The machine will mill 4 inches before it is necessary to move the base forward on the shaft. An operator can easily cut a key-seat 12 inches long, $\frac{5}{8}$ inch wide, $\frac{5}{16}$ inch deep in one hour, and other sizes in proportion.

Africa for Africans.

Mr. Robert Perry, a Chicago contractor, who has been spending two months in Johannesburg, South Africa, says: "I want to warn Americans to keep away from that part of the world. There is nothing to go there for. The climate is unhealthful, living is exorbitantly high, and the people who are there are almost in a starving condition. Negroes do all the work in the mines. The place is a desert where scarcely anything grows, and there is a water famine most of the time. Every imaginable thing is taxed heavily. Even Pretoria's own paper has printed a warning to the world to keep away from the place. The people who have lived there ten or fifteen years are away behind the times. When I told them about the motocycle and the kinetoscope, they thought I was telling fairy tales, and would not believe me."

The Switzerland of America.

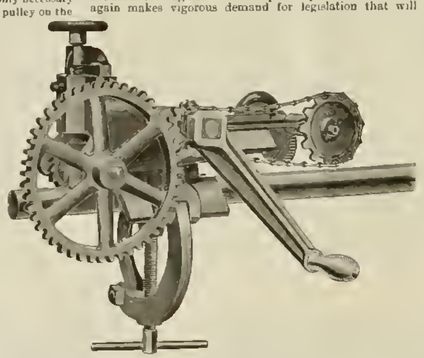
The assembly hall of the Union League, in Philadelphia, was thronged with people on Dec. 27 and 28, to see the exhibition of pictures of scenes along the line of the Lehigh Valley Railroad. The pictures were photographs by William H. Rau, of Philadelphia, made last summer. A locomotive and car, fitted up with a dark room for developing the plates and all the other appliances of a photographic studio, were placed at his disposal by the company, and the 250 or more pictures exhibited are a part of the results of his work.

The region through which the Lehigh Valley Railroad runs has often been called the "Switzerland of America" from the beauty and variety of the scenery. Many of the pictures are of scenes of which the traveler catches fleeting glimpses from the car windows as he is whirled along the Lehigh and Susquehanna rivers. Some of the pictures are of the country in the vicinity of Easton and Bethlehem, Pa., and the series of the vicinity of Mauch Chunk show the river shut in by mountains and the railroad curving in and out along the bank. But the real "Switzerland of America" is not reached until the traveler approaches Wilkes-Barre. Here glorious subjects for the artist are to be found on every side. The pictures of this region are among the most beautiful in the collection. There are pictures of Glen Summit and the beautiful Wyoming Valley, and views of forest, and mountain, and stream from Point Lookout and from Wilkes Barre Mountain. The photographs of the collieries about Wilkes-Barre, Mahanoy City, Shenandoah and Pittston are exceedingly interesting and illustrate in a novel way Pennsylvania's great mining industry. The valley of the Susquehanna River offers an endless variety of subjects for the camera. The various views of the river between Falls Station and Towanda show conclusively that the scenery along the river is varied and characterized by a beauty that must inspire the most prosaic nature. Then come the lakes. Beechwood Lake, Shawanese Lake, Lake Ganoga, Seneca Lake, Cayuga Lake, Owasco Lake and Hemlock Lake are all beautifully represented. One of these, Lake Ganoga, stands in a virgin hemlock forest of vast extent. The surrounding mountains are covered with a heavy growth of hemlock that man has never penetrated. Hemlock Lake is not far from Rochester, and although not as well known as some of the others, the prospects for its future are of the best. A new branch of railroad has been run to the lake from Rochester.

Safe Lighting of Mail Cars.

The Superintendent of the Railway Mail Service, Mr. Joseph E. White, calls attention again, in his annual report just concluded, to the necessity of adopting safer methods for lighting mail cars. For several years the Post Office authorities have pleaded with Congress to adopt a measure forbidding the use of oil in lighting the cars in which the mails are carried. In report after report the various superintendents of the Railway Mail Service have called attention to the immense losses caused the Government by reason of mail cars and their contents being burned, either by the explosion or overturning of oil lamps when accidents happened.

Such casualties frequently occur, and, as the report mentioned fully shows, the greater number of fires arising from accidents were caused by the lamps with which the cars were lighted, and only in very rare instances by the fire from the engines. In his report Superintendent White again makes vigorous demand for legislation that will



A PORTABLE KEY SEATER.

effectually prevent the recurrence of such disasters which involve such tremendous losses. He says:

"The leading bankers, manufacturers, merchants and prominent citizens of this country are very strongly in favor of greater care in the transmission of the mails, because of the immense loss and trouble caused by their destruction in railroad wrecks, when thousands of checks and drafts are destroyed, often taking years to trace up and replace. Furthermore, the average citizen who, after all, pays the freight, has a very decided interest in the matter, from the fact that letters and mementos are often lost which can never be replaced. Every business firm in the United States is vitally interested in this question, because, apart from financial considerations, important communications and orders are lost, which cannot be duplicated and frequently can never be replaced."

Burning Liquid Fuel.

An English paper, in commenting on the burning of liquid fuel, says: Hundreds of patents have been secured for different methods of spraying and burning liquid fuel. The great secret of success seems to lie in so arranging matters that the flame will not put itself out and prevent the oil from being properly consumed. If we put a bit of flaming paper over the chimney of a lighted lamp, the paper will be extinguished by the uprush of carbonic acid from the lamp flame. In the same way, when petroleum spray is directed into a furnace high up it cannot burn because the upper part of the firebox contains little or no free oxygen, the spray is driven unconsumed through the flame, strikes the bridge or fire stone and runs down it to be burned—usually badly—below. The jet of oil should enter near the grate bars, but the precise height is a matter of adjustment, involving special knowledge not to be imparted by letter press. As regards the spraying, that is usually effected by steam, but the practice is very objectionable, because the quantity used is very considerable, and represents great waste of fresh water, which must be made up again for the sake of the boilers, at least in the case of seagoing steamers. The use of compressed air appears to be better, but it is worth while to consider whether either air or steam is needed. It might be found practicable to get rid of both by driving the oil in through very fine nozzles—needled if desirable—under heavy pressure. This device has been employed in oil engines with much success, and we do not see why it should not be made to answer for furnaces.

Low Excursion Rates.

The Southern Railway (Piedmont Air Line) has just issued a circular announcing low excursion rates to Southern cities and winter resorts. The new points to which excursion tickets are sold this winter included many prominent Southern cities. This great system penetrates every Southern state over its own rails: operates solid trains, vestibuled sleeping and dining cars, from New York to New Orleans, Jacksonville, Tampa, Atlanta, Augusta, Asheville, Chattanooga, Birmingham and Memphis. This is the route that forms the great California Limited via New Orleans in connection with the Sunset Limited, the most elegant appointed train service between the Atlantic and Pacific.

The Riehle Brothers Testing Machine Company, of Philadelphia, purposes printing in a standard 6 x 9 volume, various matters pertaining to physical testing, together with such chemical analyses and other data as may be of value in determining the strength of all kinds of material. This pamphlet, beginning January, 1896, will be issued quarterly, and will be a digest of tests so arranged under appropriate headings as to make of it a ready book of reference.

There will be a receiver's sale of the entire plant of the New York Frog & Switch Company, at Hoboken, N. J., Thursday, Jan. 9, 1896. For full particulars address Mr. F. K. Day, Hoboken, N. J.

The Florida season is now fully opened up and the question of when to start and by what lines to travel is presenting itself to the Southern tourist. A pleasing choice of route is an essential feature of a railway trip. The Cincinnati, Hamilton & Dayton Railway, with solid trains, magnificent sleeping and parlor car service, quick schedules and close Cincinnati connections with the fast lines to Florida, realizes all the possibilities of modern journeying.

Dixon's Silica Graphite Paint, manufactured by the Joseph Dixon Crucible Company, of Jersey City, N. J., will be used in painting all the tin work and skylights of the Post Office Department building at Washington. A quantity will also be used on the Capitol and the District Government Building.

The Chicago Rabbeted Grain Door has been ordered on 600 new box cars now being built for the Norfolk & Western Railroad. These doors are ordered also on 500 new box cars being built for the L., N. A. & C. R. R.

Riehle Brothers' Testing Machine Company have just been notified that they have received a silver medal for the excellence of their 100,000-pound automatic and autographic testing machine exhibited at the Atlanta Exposition. This is the highest award.

The Bills & Jones Co., of Wilmington, Del., has just issued an exceedingly attractive catalogue, presenting large handsome photo-engravings of the special line of machine tools made by this company for working iron and steel plates, bars and structural shapes. The pamphlet is original in design and very artistic.

Messrs. T. Shriver & Co., of 333 East Fifty-sixth street, New York City, are Iron and Brass Founders and Machinists who make large castings in green or dry sand—being fully equipped for the purpose. A feature of their business is the making, on special molding machines, gear wheels of any diameter, face or pitch; no pattern being required from the party ordering; and fly wheels and pulleys of any diameter, or face, also without the necessity of a pattern. For castings requiring great strength they use a special mixture of iron, which they have developed in the course of their experience. They are also manufacturers of overhead traveling cranes particularly adapted to use in power rooms of street electric and cable roads, and they invite correspondence on the subject.

Our Directory

OF OFFICIAL CHANGES IN DECEMBER.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atchison, Topeka & Santa Fe.—Master Mechanic W. E. Symons, of Raton, N. Mex., has resigned.

Birmingham, Sheffield & Tennessee River.—General Manager Philip Campbell has resigned and is succeeded by Samuel Hunt.

Canadian Pacific.—William Apps is appointed General Master Car Builder.

Chicago & Eastern Illinois.—Assistant Superintendent M. P. Albert Griggs has resigned.

Chicago, Burlington & Quincy.—General Manager W. F. Merrill has resigned, and is succeeded by W. C. Brown.

Choctaw, Oklahoma & Gulf.—G. F. Huggins is appointed General Superintendent, vice J. D. Bradford, resigned.

Cincinnati, New Orleans & Texas Pacific.—Master Mechanic I. W. Fowle, of Somerset, Ky., has resigned.

Cleveland, Cincinnati, Chicago & St. Louis.—Assistant General Manager C. E. Schaff is appointed General Manager.

Erie.—W. F. Merrill becomes Second Vice-President in charge of the Operating and Maintenance of Way Departments.

Florida East Coast.—G. A. Miller is appointed Master Mechanic.

Grand Trunk.—General Manager L. J. Seargeant retires from that position and is suceeded by Charles M. Hays.

International & Great Northern.—W. C. Peterson is appointed Foreman of Motive Power and Car Department. Office at San Antonio, Tex.

Macon & Birmingham.—J. B. Lane is appointed Superintendent.

New England.—T. W. Adams is appointed Master Car Builder, office at Norwood, Mass.

Panama.—General Superintendent A. L. Rives has resigned.

Pennsylvania.—Richard Durborow is appointed Master Mechanic of the West Philadelphia shops, vice M. Garrett, resigned.

Poughkeepsie & Eastern.—E. C. Osborn is appointed General Manager.

Southern Pacific.—R. L. Herbert is appointed Master Mechanic at Victoria, Tex., vice I. B. Garnott, transferred.

St. Louis, Belleville & Southern.—J. W. Karner is appointed General Manager.

Southern Railway.—T. S. Inge is appointed Master Mechanic at Burlington, N. C.

Terminal Association of St. Louis.—E. P. Bryan is appointed General Manager.

Wisconsin Central.—A. D. Allibone is appointed Purchasing Agent, vice J. A. Whaling, resigned.

Employment.

A Master Car Builder and Mechanical Draughtsman, with a large experience in designing and constructing all kinds of cars, is open for an engagement. Best of reference furnished. Apply to office of NATIONAL CAR AND LOCOMOTIVE BUILDER.

AMERICAN ENGINEER
CAR BUILDER AND RAILROAD JOURNAL.

FEBRUARY, 1896.

CONTENTS.

The Erie Railroad is to build five engines at its own shops.

It is stated that the Wabash road will soon be in the market for 1,000 freight cars.

The Lake Shore & Michigan Southern road will soon be in the market for 1,000 coal cars.

The Madison Car Company has been given an order by the Union Pacific, Denver & Gulf for two derrick cars.

The Duluth, South Shore & Atlantic has prepared specifications, and bids are asked for the building of 500 new ore cars.

M. L. Hinman, President of the Brooks Locomotive Works, Dunkirk, N. Y., has recovered from a long and serious illness.

The Pennsylvania Railroad has fitted up a 60-foot car for the purpose of instructing trainmen in the care of steam heating apparatus.

A lift span bridge, 421 feet long, will probably be built across the Missouri River at Kansas City, from the designs of Mr. J. A. L. Waddell.

The Chicago & Northwestern Railway is rebuilding docks at Escanaba, Mich., making 226 pockets. The work will be completed and the docks in readiness by the opening of navigation.

The Maine Central Railroad is using large quantities of Nova Scotia coal, and the Boston & Maine is now trying it on its passenger locomotives, having already extensively introduced it on its freight engines.

Underground electric locomotives at the Marks Colliery in Pas-de-Calais, France, each weighing three tons, draw 30 corves, holding 15 tons of coal, at the rate of 10 miles an hour, thus taking the place of 30 horses.

The Lake Michigan Car Ferry Transportation Company, which transports freight cars on barges between Peshtigo, Wis., and South Chicago, has ordered two additional floats to be ready for service at the opening of navigation in the spring.

The Overland Fruit Despatch, of San Francisco, has placed an order with the Madison Car Company for 100 refrigerator cars, to be built under the Lorenz patents. The cars will be 36 feet long and will be equipped with the Gould couplers.

The estimate of the production of pig iron in the United States is 9,387,639 gross tons. Unless Great Britain shall greatly exceed any previous year's production of pig iron, this is the largest year's production of pig iron of any country in the world.

An Englishman has invented an automatic headlight which so adjusts itself as to throw its rays along the rails on curves. The casing is pivoted to boiler and there is a connection to the frame so that the light turns when the engine enters a curve.

The North Sea-Baltic Canal seems to have stood the test of the first serious frost better than many had anticipated. While ice had almost put a stop to navigation in the Shen and Hadersleben firths, sailing vessels could pass through the canal without any impediment whatever.

An experimental car is to be fitted with electric motors and tested on the New York and Brooklyn Bridge. The trial is to last for thirty days and, if at the end of that time it proves satisfactory, it will be retained in service. It is to be used for switching only, the cable being retained for the hauling of trains.

The new shops of the Atchison, Topeka & Santa Fe at La Junta, Colo., east of Pueblo, are now about completed, and the new machinery is being put in place under the direction of George W. Smith, Master Mechanic of the Topeka shops. The shops are small, but are unusually well built, and have a good modern equipment of tools.

The premium system of rewarding engine drivers in England for saving coal seems likely to fall into ill-repute. A man is awarded £10 at the end of the year if he has not consumed more than a certain number of pounds of coal per mile, and when a driver sees by the coal sheet that his consumption is too high, he deliberately sets himself to lose time.

The *Iron Trade Review* recently published a tabular statement of the output of iron ore from the mines of the Lake Superior region during the past forty years. The grand total amounts to 97,556,806 tons. The greatest output for any one year was in 1895 when it was 10,429,037 tons, of which 5,192,504 tons came from the recently opened Mesabi Range

The agreement for the construction of the Jura-Simplon tunnel has been definitely signed by the representatives of the Italian and Swiss governments. The termini fixed upon are Brigue, in the Valley of the Rhone, and Ossola, in Italy. Instead of a single double-track tunnel, there will be two single-track tunnels, though only one will be built at first. It is expected that the work will be completed in five years and a half.

On Jan. 6 the Southern Pacific threw open for business the new iron drawbridge across the San Joaquin River near Lathrop, abandoning the old structure. The new bridge was made by the Phœnix Bridge Co., of Philadelphia, and put in place by the Southern Pacific maintenance of way department. It has a total length of 477 feet, the draw span being 200 feet long, the south approach 62 feet and the two northern approach spans 108 and 107 feet long respectively.

During the year 1895 the Baldwin Locomotive Works built 401 locomotives. The output is about 28 per cent. in excess of that of the previous year, when but 313 locomotives were built, and about 52 per cent. of the product of 1893, when 763 locomotives were sent out. Of the 401 locomotives built during the past year, 162 were for export. There are now in hand orders for 90 engines. Of the number 20 constitute the balance of the order placed some months ago by the Russian Government. These 20 engines are now about ready for shipment.

The Pittsburgh Locomotive Works are now quite busy building new engines and on repair work. The shops have an order from the Pittsburgh & Lake Erie for ten 10-wheel freight engines with 18-inch by 24-inch cylinders, which will be larger than any now used by that company. Recently a number of 10-wheel freight engines have been completed for the Lake Shore, and three passenger engines and three switching engines for the Cincinnati, Hamilton & Dayton. A number of freight engines have been rebuilt for the Wheeling & Lake Erie, the Pittsburgh & Western and other roads.

Notwithstanding the fact that narrow gage railways have not been a success in this country, there are some 1,550 miles of these light railways in France. But, if reports speak true, they are not proving to be a very profitable investment to the government, who has guaranteed the interest on the stock for a greater portion of the mileage. Taking the lines as a whole, there was a small profit on the working during the first six months of the year, amounting to about $35 per mile. This is not a result which would allow the lines to be operated as a purely commercial undertaking, but the interest on the shares being guaranteed by the Government, the stockholders can view the situation with equanimity.

The French Ministry of Public Works has recently addressed a circular to the various French railroads with regard to some of the complications arising from the fact that enginemen are paid premiums for time made up. It is believed that certain dangers follow the custom of giving such premiums, because the enginemen are tempted to run too fast when they have lost time. These dangers are modified, it is true, by the premiums for fuel saving and by the rules fixing the maximum speeds. It is thought important to avoid excessive speeds, and yet it is no less important to avoid delays, which disarrange the traffic and cause complaints from the public, and which are often the cause of accidents. The railroad companies are requested to make a study and report concerning the system of premiums, both for time gained and for fuel saved, in their relative effects, and also to consider and report upon the practicability of a general use of registering speed records.

Mr. Clement E. Stretton, who may be called the railroad historian, calls attention in the *English Mechanic* to the fact that in some of our American passenger engines with large Wootten fireboxes the engineer is located over the driving wheels, and the fireman, while at work, stands on the tender, and commenting thereon says:

"It is a well-understood fact, both in America and in England, that practically the duties of the firemen are so great with express trains that they can give very little attention to looking out; and as the guards are so fully occupied with duties in their vans, in practice it comes to this—that the driver must take the whole "lookout" upon himself.

"The time will no doubt come (perhaps after an accident) when a man will be appointed to keep a lookout and nothing else."

It is hoped that Mr. Stretton's anticipation of an accident from this cause may not come true although it must be admitted that "in that direction danger lies."

The *Railroad Gazette* states that the Beech Creek Railroad for the year ending with June last had the heaviest average freight trainloads and at the same time the lightest passenger trainloads that we have ever seen reported. That it is a freight road is shown by the fact that for its 187 miles of railroad worked it has 2,876 freight and service cars and only 11 passenger cars, and that it is essentially a coal road by the further fact that of every 100 tons carried 94 were coal. The average trainloads last year were 14 passengers and 575 tons of freight. Substantially all of the freight goes in one direction; there was but 1 ton westbound to 55 eastbound, so that the trainloads taken out must have averaged 1,150 tons. The economy of the heavy loads, and the costliness of the light ones; are both emphatically shown by the earnings per train mile, 38 cents for passenger trains and $2.21 for freight trains, although the average rates were 2.58 cents per passenger mile and only 0.38 cent per ton mile. The latter would seem to be ruinously low, but the road earned not only its fixed charges but a dividend of 4 per cent. on its capital stock and had a small surplus left.

Among the most recent and novel applications of wire, attention is drawn in *Hardware* to the wire flywheel lately erected at the Mannesmann Tube Company's works, Germany, and especially notable, in view of the well-known fact that heavy flywheels, driven at high velocities, present such dangers of breaking asunder from the great centrifugal force developed. The wheel at the factory mentioned is described as a cast-iron hub or boss, to which are attached two steel plate disks, or cheeks, about 20 feet in diameter. The peripheral space between the discs is filled with some 70 tons of No. 5 steel wire, completely wound around the hub, the tensile resistance thus obtained being found to be far superior to that of any casting. This huge flywheel is driven at a speed of about 240 revolutions per minute, or a peripheral velocity of 2.8 miles per minute, or approximately 250 ft. per second, which is said to be nearly three times the average speed of any express train in the world. For such a constructed flywheel the length of wire is estimated at about 250 miles. The use of paper is also regarded with favor for large flywheels, the tensile strength of paper being enormous, and it is quite possible that some of the new big wheels will be built up with a paper rim.

Professor Arnold, of the Sheffield (England) Technical School, is carrying out a series of experiments which promise to have an important bearing on the future of the steel trade. Hitherto, as is well known, steel makers have had to rely upon the chemical analysis of steel for determining its composition; but practice has shown that two steels may have exactly the same chemical composition and yet one be tough and strong and the other rotten. The reason of this was a mystery until the aid of the microscope was brought to bear upon it. The difficulty has been how to prepare the samples for the microscope, and, as the result of tedious research, Professor Arnold has solved the problem, and has reduced the preparation of samples of steel to a system so easy that it can be carried out in an ordinary steel works' laboratory. The microscope has shown that steel must no longer be regarded as a homogeneous substance, containing the constituent elements discovered in iron, but that steel is more allied to geological structure, or, as Professor Arnold puts it, "steel is an igneous rock made up of crystals of pure iron, of carbide of iron with inter-crystalline spaces filled with the compounds of the constituents of steel." This is quite a new theory, and opens up a wide field of practical information for steel makers.—*Locomotive Engineer and Fireman's Journal.*

The Chicago Main Drainage Canal is to-day probably the most interesting engineering work being carried on in the world, and is an interesting exposition for contractors' machinery. The visitor to this canal is at once impressed by the great number of traveling cableways. As built by the Lidgerwood Manufacturing Company, of New York, they are to be found on nearly all the rock sections on the canal. On section two, McArthur Bros. use two cableways; on section three, the Des Plaines Consolidated Company use four; on section four, McArthur Bros. use two; on section five, the Qualey Consolidated Company use two; on section six, Mason, Locher & Williamson use four; on section seven, Locher, Harder & Williamson use one; on section eight, Mason & King three, and Locher, Harder & Williamson two. The only reason why about ten more cableways were not installed on this work was because the traveling cableway was not perfected in time. It is a fact that cannot be controverted, however, that since the traveling cableway demonstrated its present capacity no other hoisting and conveying machine was sold on the canal. One cableway was used on the river diversion work, and is now no longer used. However, the balance, 19, can be seen in daily operation—in fact, working day and night. The traveling cableway is capable of handling 600 cubic yards of rock in place per day of 10 hours, and any capacity short of that is due to the difficulty of loading the skips.

Notes on Russian Engineering.*

BY CHARLES HYDE.

At the station at which we crossed the frontier from Germany to Russia, called Eydkunnen on the German side and Virballen on the Russian side of the line, the gage of the railroad changes from the standard gage of 4 feet 8½ inches, which prevails throughout Holland and Germany, to 5 feet, the standard gage of the Russian roads. As this railroad is regarded as a means for the transportation of troops rather than passengers or merchandise, this change of gage is intended to prevent any sudden invasion from either side, the inconvenience of the change as regards the commercial use of the railways being completely ignored, the military character of this railroad in particular being still further emphasized by the fact that it runs in almost a straight line from the frontier station of Virballen to St. Petersburg, except where necessary to connect with a fortress or military station, while important trading towns on the Baltic Sea and Gulf of Finland are reached only by branches or not at all.

The Russian cars of the first class are commodious and comfortable, being constructed on the same plan as those largely used in Germany, viz., with a corridor running along one side, and private rooms connecting with this corridor running across the car. The extreme width of the car being 10 feet, allows for a corridor of about 2 feet 6 inches wide, and a room 7 feet long inside measurement. I may mention that on most of the roads there are four classes, so that one has plenty of choice as regards accommodation.

The Northern railroads use wood for the most part as fuel, which, though plentiful and clean, has the drawback inherent to a fuel of low calorific value, that the power developed is small in proportion to the weight consumed, and, consequently, the speed of the trains is slow, averaging about 25 miles only per hour. The stoppages made, too, are rather frequent, and to one anxious to get through, appear inordinately long; but as the trains do not carry dining or buffet cars, a stop of from 30 to 45 minutes about meal times is appreciated, especially as the buffet arrangements at the stations are first-rate.

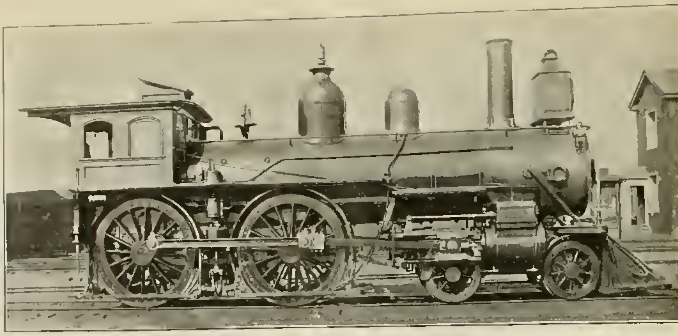
Many of the saints' days, too, are observed by closing the stores and sometimes the works, so that it is always advisable in making arrangements ahead for visiting works, picture galleries or stores, to make careful inquiries beforehand. It is also the custom, which seemed curious and just a little ridiculous, to have a shrine in each department of a works—the Bessemer open hearth rail mill, hammer shop, machine shop, etc., each having its shrine to its patron saint right in the midst of the smoke and dust of the mill; and no plant can be operated unless these shrines are provided, at least in St. Petersburg. The government also insists upon the operators of a plant providing baths, hospitals and dwellings for their employees unless the works are situated in a large city, when the latter requirements may be dispensed with.

Although the neighborhood of St. Petersburg has very few natural advantages as a manufacturing center, there are a number of important industries carried on there, principally in the hands of the government or engaged in work for the government. Among the former there are the government glass and china factories; a large plant for the manufacture of playing-cards, of which the government has a monopoly; and the shipbuilding yards, from which the largest ironclad in the Russian Navy was launched during our stay. Among private concerns engaged in government work there are the Poutilof, Neviski, Alexandrovsky and others. The first three are steel works, and each of them was visited.

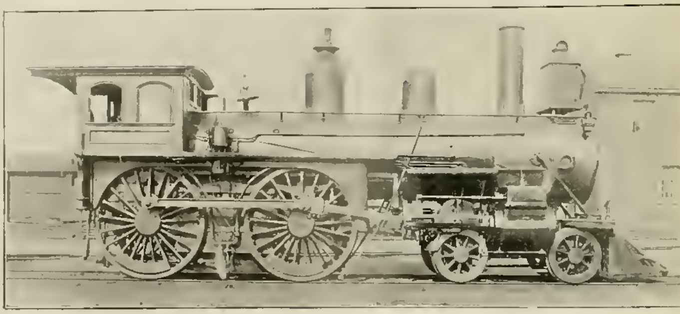
At the largest of these, the Poutilof works, they employ about 7,000 men, have a Bessemer and open hearth department, and manufacture rails, plates, beams, angles, channels, axles, tires, bars and general merchant iron. In addition to this they build locomotives, torpedo boats, gun carriages, bridges and buildings, and also have a special department for the manufacture of projectiles, which department no visitor is allowed to see. Some of the product, however, was exhibited—among other things a solid shot which had passed through an armor plate, the point of the shot being practically as good as when fired.

The whole of their raw material is imported, principally from England, and a six months' supply of pig, coke and coal must be stocked before the winter sets in. The duty on everything is high, which, together with freight, makes coal cost from

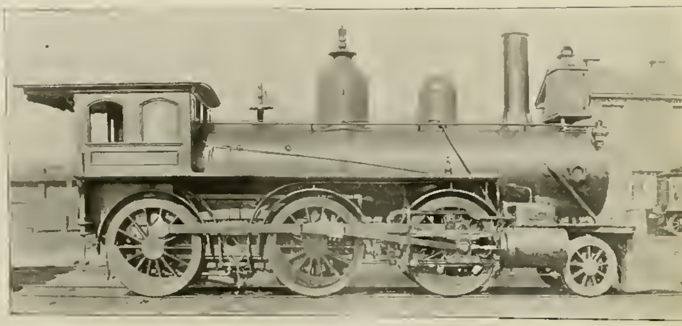
* Abstract of a paper read before the Engineers Society of Western Pennsylvania.



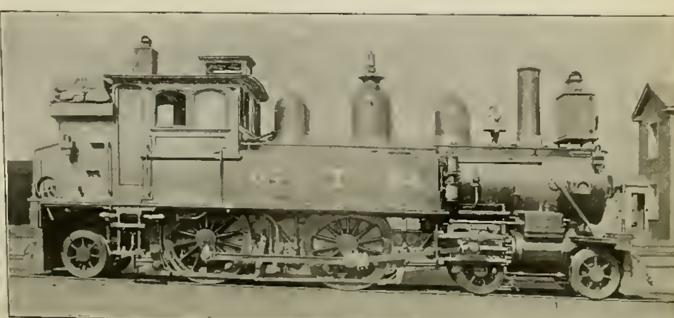
Express Passenger Locomotive with 18-inch by 24-inch Cylinders.



Express Passenger Locomotive with 18-inch by 26-inch Cylinders.



Mogul Freight Locomotive with 18-inch by 26-inch Cylinders.



Double Ended Suburban Passenger Locomotive with 17-inch by 22-inch Cylinders.

STANDARD LOCOMOTIVES OF THE GRAND TRUNK RAILWAY.

$4.40 to $5 per ton, and coke $6.80 to $7.50 per ton, and pig iron $27 to $28 per ton.

The Bessemer department contains two 4-ton vessels, three iron-melting cupolas and one spiegel cupola. The spiegel is tapped directly into the pouring ladle and not into the vessel; hydraulic pressure used for cranes, tilting, etc., is about 300 pounds per square inch. The open hearth department contains twelve 10-ton furnaces in a straight line, having a casting pit extending the full length, the ladles being carried on trucks extending across the pit, and running on rails laid on either side. The molds and ingots in this department are handled by traveling steam jib cranes, which seem to answer the requirements very well. Ingots for rails are bloomed down on a reversing mill in 10 passes to an 8-inch bloom, which is transferred on a buggy to a three high rail mill, and finished in 11 more passes. The capacity of this mill is about 200 tons per day, all the work of drawing and charging the furnaces, transferring and manipulating being done by hand. Labor-saving appliances are but little used in any of the Russian mills, especially in St. Petersburg, as labor is cheap in spite of the high tariff on everything—common labor being paid about 40 cents a day and skilled labor from $1 to $1.50.

The finished product of both the rail and structural mills looked first class, in fact it must be good to pass the very rigid government inspection, while the steel castings which they were making to take the place of forgings in gun carriages and locomotive construction equaled anything of the kind I ever saw.

The plate mill department is rather old-fashioned, having been built 15 or 20 years ago; the widest plate they could roll would be about 80 inches, I should judge; and in this department, as elsewhere, the number of men employed appeared excessive for the amount of material turned out as compared with our modern mills.

In the locomotive shops a great deal of new machinery had been recently added, and the general equipment was fairly good, but too crowded. Overhead cranes, some operated by steam, some by ropes and some by electricity, handled the material in the smith, machine, hammer or erecting shop, as the case may be, and the flanging and riveting work on the locomotives turned out was first-class in every respect. The government inspection was not only rigid, but absurdly arbitrary in some respects, though any one who has had much to do with government work knows perfectly well that unreasonable requirements and arbitrary inspection is not confined by any means to Russia.

The compound type of locomotive seems to be coming into very general favor, there being several different arrangements in use, though the favorite type appeared to be with the high pressure on one side and low on the other.

In the St. Petersburg mills, for the most part, the mill engines are of the non-automatic type, while as to boilers, I noticed in the Poutilof works, alone, boilers of the modified Babcock & Wilcox, the Lancashire, Cornish, horizontal tubular locomotive and plain cylinder type, many of these boilers being fired by the waste heat from heating furnaces.

At the "Nevski," another large works on the Neva, above St. Petersburg, there are two open-hearth furnaces of the acid type, as are all those at the Poutilof, and here also they build torpedo boats and locomotives. As illustrating the extreme rigidity of the government inspection I was informed that out of 200 plates submitted to the inspectors for the artillery department only 24 were accepted, the rest being rejected principally on tensile strength and ductility test. Sixty plates were ordered from the Belgian firm of Cockrill & Co., in order to complete their contract, and out of these 60, 48 were rejected.

At the Alexandrovsky works, the principal output of which consists of plates and structural material, they have seven open-hearth furnaces, of which six are operated by the basic process. The metal is tapped directly from the furnace into the moulds, they being set on a revolving table in a small circular pit and brought alternately under a fixed funnel.

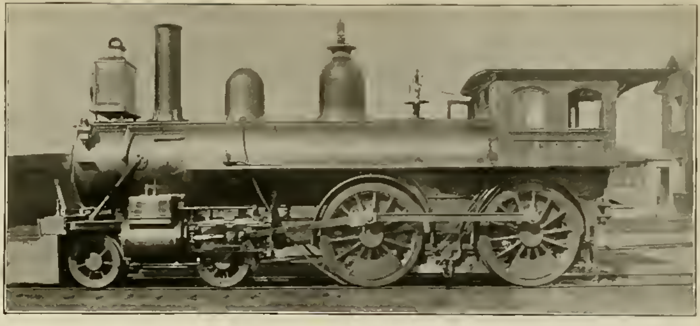
The object of this arrangement was, presumably, to save expense for pits, cranes and ladles. What the effect would be if the furnace broke out, as furnaces sometimes will, can be readily imagined by any one familiar with open-hearth practice. It is bad enough where you have a clear pit and good crane capacity without having a lot of mechanism in the pit, and cranes capable only of handling moulds and ingots to depend upon.

For rolling their plates they have a reversing mill operated by a three-cylinder engine, and all the plates are passed through straightening rolls as they come from the mill. The result is a very fine-looking plate of smooth surface and free from buckles. Very little handling is done here by mechanical means, as many as 17 men being required to draw a 5,000-lb. ingot from the heating furnace and take it to the rolls.

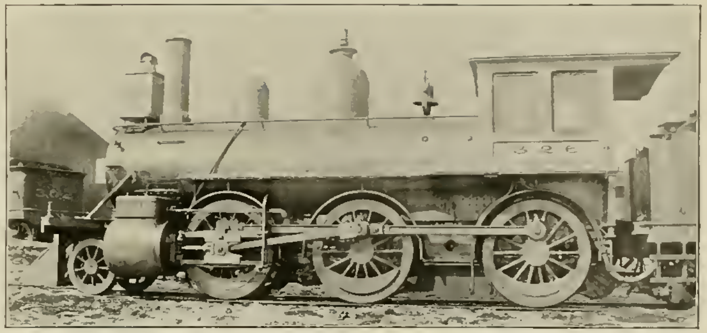
At Moscow, at the Gougon works, the arrangement of the open-hearth plants struck me much more favorably than did that of the St. Petersburg works, though, of course, the latter plants were older. At the Gougon works the furnaces, two in number, were of about 30 tons capacity each, with plenty of room both on the side of the charging floor and on the pit side, which was also properly equipped with hydraulic cranes. Crude petroleum from the Caspian Sea, brought up the Volga and Oka rivers in bulk in covered barges, is largely used for fuel at these works both for heating and boiler purposes, but it is not used in the open-hearth furnaces, nor did the method of using it seem the most economical. At the end of the furnace, and on the outside, the oil is allowed to fall in drops into a shallow iron trough, where it is ignited and is drawn by natural draft into the furnace. At these works, too, they have recently put in some compound automatic engines built in England; have a good modern mill, and well-equipped nail, spike and wire factory. For this class of work they can compete successfully with other districts, but for heavy products they are handicapped on account of the high freights on all raw material. For fuel they are dependent upon coal and coke from England or Germany, or oil from the Caspian, a distance of some 1,500 miles, while much of their pig iron is either imported or comes from the Urals, a distance of a thousand miles.

As regards oil, too, all this distance is against the stream, and the Ural pig must come against the stream for at least half the distance, and I know from personal experience what pulling against the stream in the Volga means. During half the year, too, the rivers are not navigable on account of the ice.

Although there is an abundant supply of rich ore in the Ural Mountains, it is impossible to smelt it in large quanti-

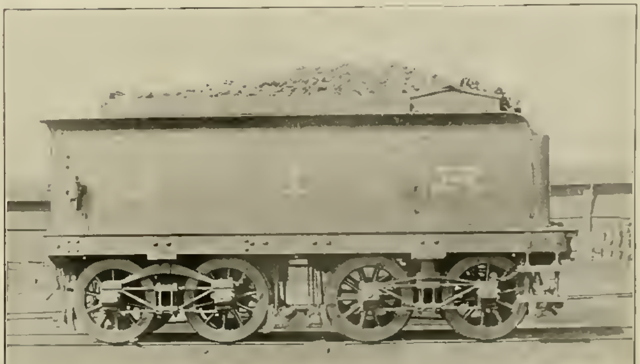


Light Passenger Locomotive for Local Service with 17-inch by 22-inch Cylinders.



Experimental Compound Locomotive of the Rhode Island System.

STANDARD LOCOMOTIVES OF THE GRAND TRUNK RAILWAY.



Standard Tenders Used on the Grand Trunk Railway.

ties there, owing to the absence of any fuel except charcoal; the government restrictions as to the quantity of timber felled in any district per annum, and other requirements as to smelting, rendering it difficult to produce iron in large quantities in this region, though the finest ores in Russia, and possibly equal to anything in the world, are found here. There is a fortune in it for any one who can devise a practical means of smelting Ural ore with crude petroleum, as the ore can be floated down to any point on the Volga to meet the oil from the Caspian.

Several schemes have been proposed, among others to soak coke in petroleum, and use the standard coke, which might possibly be of use if you could keep the oil from volatilizing long enough to be of any use in reducing the ore. Others claim to be able to reduce the ore by means of the oil, without the use of coke at all, but the schemes referred to me did not seem to hold out much hope of success.

The coming district in Russia for the manufacture of steel on a large scale is undoubtedly in the south, as that is the only district where coking coal is found in large quantities of a good grade; and here, too, there are some good hematite mines, notably at Krivoi-Rog.

The most successful plant in this neighborhood, and possibly in Russia, is the New Russia Iron Works, founded by a Mr. Hughes, an Englishman, in the early seventies, and recently converted into a joint stock company, with offices in London.

Situated on the Donetz coal field, they raise the coal right in their works yard, and have some hundreds of Coppee coke ovens, starting from the pit mouth and extending down to the blast furnaces, so that no unnecessary expense is incurred for re-handling.

Their blast furnaces are of modern design, are well equipped with hot blast stoves and independent blowing machines, and are capable of turning out about 200 tons of pig per day each.

At present all the steel for rails, which is their principal product, is made by the open-hearth acid process, but the metal is charged in a molten state from the blast furnaces. Their main reason for building an open hearth instead of a Bessemer plant was because at that time all the railroads in Russia were using iron rails, and they proposed to melt old rails and convert them into steel, which promised to be a remunerative business until, during the American boom of 1881, the price of iron rails rose to such a figure that the whole country was scoured for them, they being sold in large quantities, and imported steel rails put down in their place.

The Hughes Company are now, however, erecting a Bessemer plant and rail mill on modern lines, which will greatly increase their capacity and reduce the cost of manufacture.

At Sulina, on the extreme eastern edge of the Donetz coal field, and where the coal is a friable anthracite, the Postuchoff works are operating two blast furnaces with anthracite for fuel—the only two so operated in Russia—and the remainder of their plant is fired by the raw anthracite, or by gas prepared from the more friable and gaseous portions. At this point they obtain on the property on which the works stand limestone, building stone, silica sand, iron ore and coal, so that the location would seem to be an ideal one for a steel works, which would be the case if the iron ores were richer in iron and contained less phosphorus, and the coal were coking coal and contained less sulphur. They were about to erect two open-hearth furnaces here, one acid, one basic, using chrome ore from the Caucasus for lining the latter furnace.

In connection with this plant, where we were treated in the most hospitable manner—which, to be perfectly fair, was the case in connection with practically every works in Russia which we visited—the manager was anxious to have some particulars of the working of blast furnaces, on anthracite, in the United States, as regards the dimension, output, consumption of fuel per ton of pig produced, pressure of blast, etc.

Speaking generally of the steel and iron industry in Russia, it is more advanced than is generally supposed by outsiders, and though many of the mills are a little out of date, they were well up with the times when they were built, and with the recent revival of business there, and the encouragement given by the Government to open up new districts by the building of railroads, the manufacturers are taking advantage of the opportunity to remodel their plants on the most modern lines. The locomotive works of the Strauvee Company at Colomna are being equipped throughout with electric overhead cranes, hydraulic riveters, multiple drills, etc., and in the case of large tools, each one is driven by an independent motor. The Siemens-Halske Company have a large and successful plant in St. Petersburg, from which they ship motors and general electrical appliances all over Russia, and at the same time give object lessons, by the way in which their own shops are operated, as to the best and cheapest methods of running machine shops and similar establishments.

One of the oldest steel works in Russia is the Sormovo works at Nijni-Novgorod, where, besides making plates, tires and axles, and general merchant iron, they also manufacture a great many freight and passenger cars, and build compound engines for the vessels plying on the Volga. We traveled all night from Moscow to see these works, only to find them standing on account of its being a saint's day.

The town of Nijni-Novgorod is most widely known as the site of the great fair that takes place in August of each year, which it is said as many as 750,000 people annually visit either for trading or sight-seeing. But it is expected that the construction of the Siberian Railroad will soon reduce the importance of the fair, if not kill it altogether, as the necessity of its existence will cease as soon as communication with the people interested becomes rapid and regular.

Russia to-day offers a very inviting field for the establishment of manufacturing industries, especially in the direction of iron and steel, and more particularly as regards material required for railroads. The works visited by us were all running full time on orders showing good profits, and the government had some large contracts for rails, locomotives and armor plates to give out, some of which have since been placed. At present the building of railroads is hampered by the difficulty of obtaining rails and equipment, and with the present capacity of the mills and factories, it will take years to make up the existing deficiency, without counting the extensive districts in Russia itself, outside of Siberia, which are without railroad communication of any kind.

Rails were worth $47 to $51 per ton in St. Petersburg when we were there, or about $40 at the mills in the south, there being a duty of $20.50 per ton. Plates were worth about 4½ cents per pound, with a duty of $29 per ton and tires 5½ cents per pound. The duty on light sheets amounts to $34 per ton, and the selling price about 5 cents per pound.

As good pig iron can be produced in the South from $17 to $18 per ton, and rollers are paid from $1.60 to $1.70 per day in rail and structural mills, puddlers and sheet rollers, $1 to $1.20 per day; helpers from 45 to 50 cents per day, and common labor 35 to 40 cents per day, it will be seen that there is a very fair margin between cost and selling price, though from the number of men employed, and the difficulty of getting material good enough to pass the government tests, the returns are not as large as they appear on the surface. Still, with modern machinery and assured government contracts, which would be necessary, as the government is by far the largest buyer, Russia appears to offer one of the best fields in the world for investment to-day.

The great steam hammer, at the Bethlehem Company's works in Pennsylvania, is at this time the largest one ever made. It is single-acting, that is, the falling movement or blow is by gravity alone, steam being employed only to raise the "tup," as the British people call it. The falling weight is 125 tons, and the range 16.5 feet. The whole structure is 90 feet high from the floor, and the foundations extend 30 feet below, so the whole height is 120 feet. The piston rod is of steel, 16 inches in diameter. There are in use two other hammers of 100 tons, one at Creusot, and one at Rive de Gier, France; and one of 100 tons at Terni, in Italy. The next largest is 80 tons, at St. Chamond, France.

The largest double-acting hammer is at Aboukoff, in Russia, rated at 50 tons, but this rating will not do to compare with gravity hammers. The blows may equal in force 100 tons falling only. The great hammer at Bethlehem is outdone by a hydraulic forging press recently erected there that exerts a pressure of 14,000 tons. The force is not accumulated, but is direct by steam pistons acting on the water with a force estimated as equal to 16,000 horse power.

If the effect produced by these vast engines could be accomplished irrespective of speed or velocity there would be no need of such great weight, but an element of time enters into these forging processes, necessary because of inertia in large masses to be reduced, and also because some time must be allowed for the heated metal to flow when under pressure. This is more nearly attained by a heavy weight falling slowly.

The increase of hammers to the enormous proportions named is to acquire this time required, the principle culminating in the forging presses, more commonly employed all over the world for heavy work, especially in England, where hydraulic apparatus has attained the greatest development. The presses acting slowly permits the metal to move uniformly throughout, or "to the center," as it is called, while a quick blow acts only on the surface.

A familiar example of this is in the use of hand hammers which, as all know, must have weight in proportion to the object struck, independent of the dynamic energy of the blows. Pile driving is another illustration. A light ram splinters the piles without moving them.—*Industries.*

The Standard Locomotives of the Grand Trunk Railway

The officials in charge of the mechanical departments of the Grand Trunk Railway have taken great pains to standardize all parts of their rolling stock, so that the expenses for repairs have been lowered and the necessity of carrying a multiplicity of parts avoided. Their standard box car was illustrated and described in the *American Engineer* in 1895, and we now present a series of illustrations of the standard locomotives that are used, including all with the exception of the switching engine.

The class of which No. 82 is a representative is used on express service where the trains are comparatively light. The cylinders have a diameter of 18 inches, with a piston stroke of 24 inches and drivers 6 feet 1½ inches in diameter. It will be noticed that the tires on the drivers of this engine are held by Mansell retaining rings, that the connection for the driver brake is outside the wheels, and that while the portion of the engine above the running board shows the touch of the English influence in the smoothness and simplicity of the outlines, the mechanism is typical of American practice.

No. 93 belongs to a heavier class. Its cylinders are 18 inches diameter, with 26-inch stroke, and has drivers 6 feet 6 inches in diameter, which are of wrought iron, with tires held by the Beattie clip and tire bolts. It is used on the heaviest and fastest express service of the road, and, besides its weight and the dimensions of cylinders and driving wheels, is very similar to No. 82.

No. 572 represents the standard freight locomotive. Its cylinders have a diameter of 18 inches and a stroke of 26 inches, with a driver diameter of 5 feet 2 inches.

In No. 39 we find a double ended locomotive used in suburban passenger service, for, though Montreal is a comparatively small city, there is quite a heavy suburban traffic especially during the summer months. These locomotives haul five cars and are capable of picking up to speed with great rapidity. The cylinders are 17 inches by 22 inches, with 5 feet 2 inch drivers. The engine is practically an ordinary eight-wheeled locomotive with a trailing truck having two wheels. Engines similar to this have been in use on the Long Island Railroad for a number of years. This latter road had a number of light eight-wheeled passenger engines that were not heavy enough for regular service, so the tender was dispensed with, tanks placed along the running board, and a small coal space provided at the back. These Grand Trunk locomotives are similar, except that they were especially designed for the service in which they are working and have the advantages of ample coal and water space.

Finally we have the light passenger locomotive as illustrated by No. 196. The cylinders are 17 inches in diameter with a piston stroke of 22 inches, and drivers 5 feet 2 inches in diameter. The engine is used on local and accommodation trains.

On all of these engines it will be noticed that there is a great similarity in the design of all of the working parts, and that there is one feature that is very rare on this side of the border line. We refer to the jacketing of the firebox. The usual custom prevalent here of leaving the firebox to the tender mercy of all the breezes of heaven is a necessity for that portion of the firebox between the top rail of the frame and the running board, where it is occupied by the reach rod and the equalizer; but between the rails there is nothing to interfere with the jacketing, so our Canadian brethren, believing that a half loaf is better than no bread, have filled this space with a protective jacketing.

The compound locomotive illustrated is the only one that is owned by the road, and so has not arisen to the dignity of a class. Elaborate experiments are being conducted in order to determine its efficiency both in passenger and freight service. It has the Rhode Island type of intercepting valve. The cylinders are 19 inches and 29 inches in diameter, with a piston stroke of 26 inches, and drivers 5 feet 2 inches in diameter.

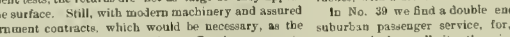


Fig. 4

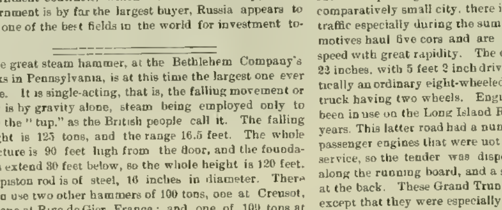


Fig. 3

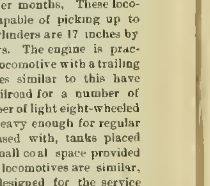


Fig. 5

All locomotives upon the road are equipped with the one standard tender. This is illustrated very clearly by the engraving which we present. The tires are held by Mansell retaining rings, the brakes are hung from the framing, the truck is of the diamond type, with an intermediate arch bar, and the flare of the tank is curved instead of being straight, as we are accustomed to see it.

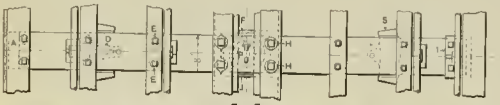


Fig. 7

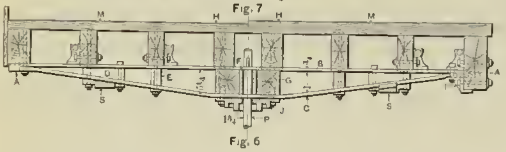


Fig. 6

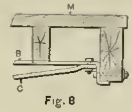


Fig. 8

The table on page 29 gives a very complete list of the dimensions of these locomotives, while those of the tender used are as follows:

PARTICULARS OF STANDARD TENDER, GRAND TRUNK RAILWAY.

Weight of express tender, empty (43-in. wheels) . . . . . . .31,911 lbs
Number of wheels under tender 8
Diameter " " " 37 in. and 13 in. for express and 33 in. for freight.
Style of " "C. I." center, steel tires and "Mansell" clips.
Axles, center to center of journals . . . . 6 ft. 4 in.
Diameter and length of journals . . . . 3⅞ in. × 7 "
" of wheel seat . . . . 5¾ "
Trucks, from center to center of truck wheels . 4 ft. 8 "
" " " " trucks . . . . 10 " 6 "
Springs—Front truck, center bearing springs, length, 3 ft. 8 in. unloaded, by 1 ft. ½ in. set unloaded Number of plates, 14; section of steel, 4 in. × ½ in.; back truck, center bearing and side bearing springs, length of center bearing springs, 3 ft. 7½ in. unloaded by 1 ft. 1½ in. set unloaded; number of plates, 11; section of steel, 4 in. × ½ in.; length of side bearing springs, 4 ft. 4½ in. unloaded by 1 ft. 1½ in. set unloaded; number of plates, 10; section of steel, 4 in. × ½ in.
Total wheel base of tender . . . . 15 ft. 2 in.
" length of tender over all, express . . . . .23 " 6¾ "
" " " " " freight. . . . . 22 " 3½ "
Style of frame, wood, length by width . . 20 ft. 8 in. × 8 ft. 9 in
Capacity of tank in gallons, of 231 cubic inches . . . .3,600 gals.
Coal capacity of tender in pounds . . . . . . 20,000 lbs.
Tank—Length, width, depth, 20 ft. × 8 ft. 4 in. × 3 ft. 8½ in. inside.

Construction and Maintenance of Railway Car Equipment. II.

BY OSCAR ANTZ.

(Continued from Page . .)

Body Bolsters.

The body-bolsters have to carry the entire weight of the car body and transmit it to the trucks, and must therefore be made strong and stiff. As the distance between the bottom of the floor-frame and the top of the truck-bolster is limited, the body-bolster, which has to be placed within these limits, together with the center plates, must necessarily vary somewhat with the conditions encountered; in a great many cases, however, when building different classes of cars, a design can be adopted which will suit the greater portion of these cars of the same capacity with few if any changes.

Although there is considerable variation in the details of the design and construction of body-bolsters, the general idea of all of them, with few exceptions, can be traced to one of two designs or a combination of these, leaving out of consideration for the present, bolsters of recent construction made of pressed steel.

The first and simplest body-bolster is the wooden one, which has been in use since cars with independent trucks were first built, being merely a piece of timber at each truck center, extending across the car under the floor frame, from outside to outside of side sills, and to this timber the body center plate and side bearings are fastened. At first this bolster was of small cross-section, in proportion to the rest of the frame, but as the strength of the cars was increased, it was made heavier, and eventually provided with truss rods. On modern cars of a capacity of 60,000 pounds having wooden body bolsters, each of these is about 5 or 6 inches thick and 18 inches wide, and is trussed with two 1-inch to 1¼-inch truss rods. It is gained out ½ inch for each longitudinal sill and each of these is also gained out ½ inch for the bolster, whereby displacement in either direction is guarded against. The bolster is fastened to each longitudinal sill by two or more bolts and usually some of these bolts are utilized to hold the attachments on the bolster, viz.: center plate and side bearings.

In Figs. 3 and 4 the part to the left of the center line shows a wooden body bolster *AA*, and its general relation to the frame of the car, where all the sills are of the same depth.

Cars which have the side sills deeper than the other sills require a change in the end of the body bolster, and in the earlier cars this was framed into the side sills by mortise and tenon. With the heavier cars, however, this fastening was not substantial enough and a casting in the shape of a pocket, into which the end of the bolster was framed, was resorted to, and this in turn was bolted to the side of the side sill and lipped under it, as shown at *BB* to the right of the center line in Figs. 3 and 4.

The truss rods of wooden body bolsters are usually made in three pieces, which facilitate their application and removal. The two end pieces are from 1 inch to 1¼ inches in diameter and have large cast or wrought iron washers, *HH*, under the nuts on the outer end, the plane of contact with the nut being at right angles with the line of the rod. The central part of the truss rod is preferably made of flat iron, to distribute the strain over a larger surface of the center sills, and sometimes castings, *EE*, are introduced, which are bolted to the sills and give additional support to the rods.

The usual methods of connecting the three parts of the truss rods are shown in Figs. 3 and 4, the one on the right being a jaw connection, *CC*, which is an easy one to make, but it requires the removal of the floor for its application. The one shown on the left, *DD*, can be connected from the outside without disturbing the floor, and although it is more expensive to make than the first it is the more extensively used of the two.

To further strengthen wooden body-bolsters the width is sometimes divided into three parts and plates of iron ½ inch thick *FF* are inserted between these pieces, the whole being securely bolted together. The iron plates should not be quite as deep as the wood, so as to be below the notches which are gained for the sills, and to prevent their projecting beyond the wood if this should shrink.

This style of bolster is shown in Figs. 3 and 4 to the right of center line and in cross-section in Fig. 5. It is not a popular construction, as the wood is liable to shrink, leaving the bolts loose, whereby all the advantage gained by the introduction of the plates is lost.

The second kind of body-bolster, the iron one, Figs. 6 and 7 is the favorite with car builders at present. This is made of two bars of flat iron, the upper one straight and the lower one bent in the form of an inverted arch, the ends being fastened together and the bars spaced as far apart at the center as is necessary and possible, the distance at this point being limited by the space between floor frame and truck-bolster. This makes a strong and stiff bolster, which is easily repaired and allows part of the draft gear to be carried through between the top and bottom members to the center of the car, so as to distribute the shocks to which the draft rigging is subjected to the framing. The space between the two members also provides a convenient location for air-pipes and brake rods, keeping them away from the top of the trucks.

Sometimes the two members of the body-bolster are welded together at the ends, but this is not an advisable plan and is not widely practiced at present. A better method of fastening is to weld a lug on the bottom of each end of the top member, about 2½ inches wide and of the depth of the lower member, against which lug the latter bar is made to fit neatly, as shown at *AA*.

The usual width of iron bolsters for 60,000 pounds capacity cars it 8 inches, but a few roads use them a little wider. The thickness of the upper or tension member *BB* is generally ⅞ inch, and that of the lower or compression member *CC* is ⅞ or 1 inch. The two bars are well bolted together, with distance pieces between them to preserve their relation to each other. These distance pieces have been made of wood especially where the bars were welded together at the ends and then usually the entire space is filled, excepting, perhaps, at the center. The wood, however, is liable to shrink and it is therefore not very extensively used for this purpose, and castings or thimbles of wrought iron pipe are applied instead. When two or more bolts come close together, one casting, as at *DD*, can be made to take them all, at other points it is usual to have a separate casting *EE* for each bolt, usually cylindrical in shape, and often enlarged at the ends in order to distribute the bearing surface. At the center of the bolster a casting *FF* is sometimes placed, through which the center-pin passes, which is lipped over the sides of the bolster and is held in place on the sides by parts of the draft rigging. When bolts pass through timbers such as these just mentioned, distance pieces made of wrought iron pipe *GG* can be used to advantage, as castings would necessitate too much of the wood being cut away.

The bolts which tie the two bars of the bolster together are usually carried up through the floor-timbers, and with the exception of those at the center, have plate-washers under the heads resting on the sills; although on box and other cars with a framed superstructure the bolts through the ends of the bolster are often utilized to hold some of the pockets in which the posts and braces rest. The bolts at the center occasionally require removal, as in the case of repairs to the draft gear, and the heads of these bolts should therefore rest in cast-iron sockets *HH* let in flush with the top of the floor. These sockets are usually cylindrical, with thin lugs on them to prevent turning. The bolts mentioned are also utilized where possible to fasten the center plate and side bearings, and their number and size are determined by the requirements of these attachments. The bolts through the center plate are four in number, ⅞ inch in diameter, the balance being of ⅝ or ¾-inch iron, two to each longitudinal sill, and those which do not pass through the side bearings have cast-iron washers under them, shaped to the angle of the bolster at their respective locations.

The bolster just described is shown in Figs. 6 and 7, the parts to the left of the center line being for a car with all sills of the same depth. For cars of different widths the same pitch can be preserved for the lower member, excepting between the outside intermediate and the side sill, where the end must be curved to suit the different width of car. By this means the same distance castings and other attachments can be used throughout.

On cars with side sills deeper than the other sills the end of the bolster is mortised into the side sill, and is further supported by a casting, *II*, securely bolted to the bolster and side sill and lipped under the latter; the upper part of this casting can also serve as a saddle for the body truss rod. Figs. 6 and 7 show this arrangement on the right of the center line, the truss rods being spaced for a car with central drop doors.

Another method of supporting the end of an iron bar-bolster, where the side sills are deeper than the others, is shown in Fig. 8; the upper member is carried down on the inside of the side sill and lipped under it, the compression member is fitted against the upper corner so formed and is securely bolted to it, the tension member being bolted to the side sill.

As mentioned above, the distance between the two members of an iron bar-bolster is limited and usually does not exceed six inches. If more of an arch is desired, or when, on account of an unusually low floor or high truck, sufficient space between the latter parts cannot be obtained for a proper depth of bolster, the tension member can be placed on top of the floor timbers, as shown in Figs. 8 and 9, carried down on the inside of the sills, and under them. The compression member, which is placed below the sills, being turned up on the ends and fastened near the upper corner to the tension member, as at *A*, or it may be fastened to castings, *B*, which themselves are bolted to the tension member and side sills. In these cases the sills act as distant pieces between the two bars; at the center it is usual to place a casting or piece of timber, *C*, between the bottom of centre sills and compression member, the outside intermediate sill has to be cut away, as at *D D*, on the bottom, for the compression member, which is an objection to this style of bolster; another objection is the fact that the tension member cannot be removed without considerable work.

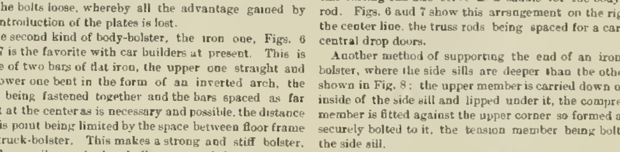


Fig. 10

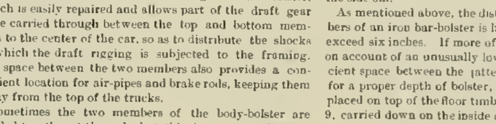


Fig. 9

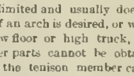


Fig. 11

This style of bolster can be used advantageously in cases where the draw-bar attachments are fastened directly to the center sills of the car.

A combination of the wooden and iron body bolsters, is used on some roads, an iron-bar bolster, 6 inches wide, with the tension member on top of the sills is reinforced on each side by a piece of timber, *EE*, 5 inches deep and 6 inches wide, making a bolster 18 inches wide, the bottoms of the iron and wood being in one plane at the center; castings which lap over on to the wood parts are placed between the center and inside intermediate sills and the compression member of the iron part. Figs. 9 and 10 shows the general arrangement of this combination bolster to the right of the center line; it is shown in cross-section in Fig. 11. In addition to the body bolsters described, a number of others have been designed in which iron or steel channel bars or *I*-beams are used, but as comparatively few of these are in existance, and these principally on special kinds of cars, they will not be described here in detail.

Center Plates.

Center plates are usually made of cast iron, although pressed steel is coming into use to some extent. Those of cast iron are limited to one or two styles, the more common being that shown at *JJ*, Figs 6 and 7, which consists of a ring of rectangular section cast to a flat plate, this ring fitting loosely into a similar ring on the truck center plate. The size of the section, as well as the diameter of these rings vary greatly, but four inches for the inside

Side Bearings.

The weight of the body of a car is carried entirely by the center plates when the car is on a straight and level track, and the weights of the body and load are evenly distributed each side of the center line; these conditions however, do not always prevail, and the center of gravity will not be directly over the center of the truck. As the center plates are comparatively small, other supports must therefore be provided to meet these conditions and to prevent undue and often dangerous oscillations when passing around curves at a high speed. These supports are the side bearings, *SS*, which are placed near each end of the bolster and are fastened to it by two or three $\frac{5}{8}$-inch bolts. They are usually made of cast iron, with lugs on the sides for the bolts and flanges on the ends fitting over the bolster, and in their most common form the surfaces of contact on both body and truck side bearings are sections of flat rings, about three or four inches wide, drawn from the center of the truck.

When the car body is balanced there should be a space of about $\frac{1}{4}$ inch between the body and truck side bearings, but this is sometimes difficult to maintain on account of shrinking and bending of timbers and loosening of fastenings, and many cars are found on which the side bearings are in contact, causing more or less friction when rounding curves. To overcome this bearings have been designed in which a roller is supposed to do away with the friction,

pin cannot be removed or replaced conveniently, especially when the car is loaded. The pin shall have a slot in its upper end, through which a flat key of wrought iron passes, which rests on the top of the body-bolster and can be removed easily to allow the pin to drop low enough to remove the truck. This key should be about $\frac{5}{8}$ by 2 inches in section, with a head on one end and the other end long enough to have a hole drilled in it to take a ring or cotter.

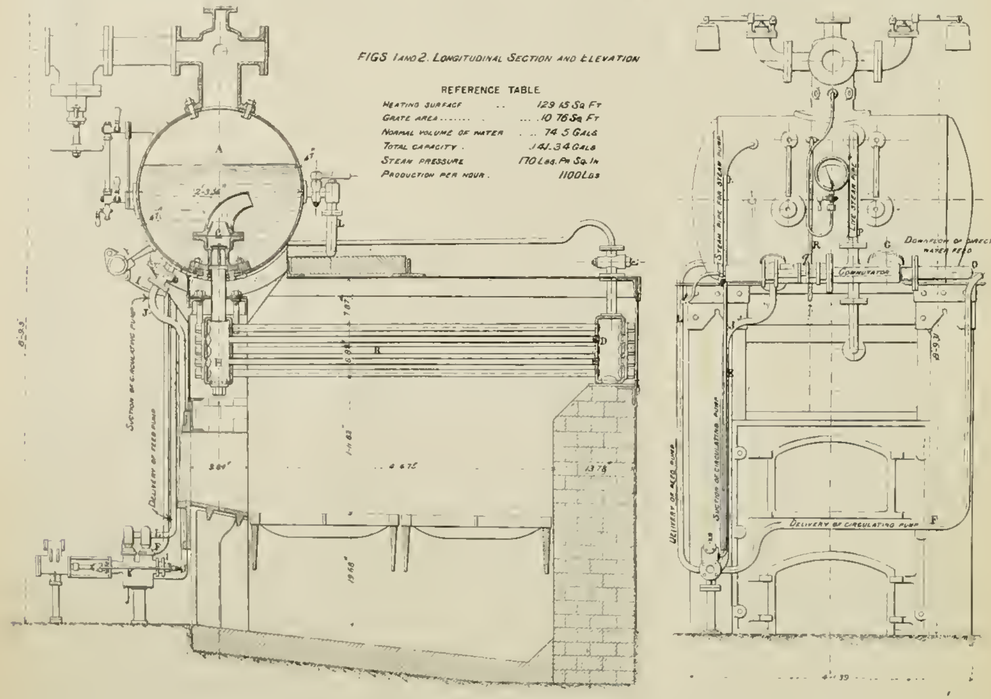
Both ends of the centre pin should be drawn down slightly tapering, to facilitate placing.

If a head is used on the centre pin it should not be made by upsetting the iron, but of a ring welded on, which can be broken or chipped off more readily in case the removal of the pin should be required in an emergency.

Floor.

The floor of freight cars, *MM*, is generally made of yellow or Norway pine and occasionally of oak. It is laid across the car, and is blind nailed securely to each sill. On box and other sheathed cars it extends to the inside of the sheathing, excepting in the doorway, where it is flush with the outside of the sheathing. On flat and gondola cars it is usual to have the floor extend about an inch beyond each side and end sill.

Floor boards are either tongued and grooved, or lapped, and vary in width from 6 to 10 inches. The thickness varies from $1\frac{1}{4}$ to 2 inches on cars on which the floor is subjected to only ordinary wear, such as box and other merchandise



The Solignac Mixed Boiler.

diameter of the smaller ring is about the minimum, while the largest diameter is usually less than 12 inches, the section of the ring ranging from 1 to to 2 inches each way. Some builders use two concentric rings on both top and bottom center plates, and their section is then about one inch square. This is shown at *GG*, Figs. 3 and 5. The other style of center plate consists of a section of a sphere on the body plate, resting in a section of a hollow sphere of the same diameter, which is about 10 inches on the truck center plate. At the center there is usually a small rectangular ring on the truck center plate fitting in a corresponding recess in the upper one, which prevents displacement. The idea of the sphere is to allow a certain amount of adjustment between body and truck of the car. Center plates ordinarily have flanges or lips on the sides which fit over the bolster and relieve the bolts of some of the strain. On wooden bolsters, especially when they are very wide, the flanges are sometimes omitted, and lugs are placed on the flat side of the plate which is let into the wood. These lugs are often made cylindrical, about one inch in diameter, and of the same length, but it is found that they frequently break, and stronger ones of rectangular section, about $1\frac{1}{2}$ inches square and 3 inches long should therefore be used.

The center plate should be fastened very securely to the bolster, and four bolts $\frac{3}{4}$ inch in diameter are found to be about right

but they have not proven much of a success, as the roller would soon wear flat and become stationary.

Several designs of roller side bearings embodying the well-known idea of a number of small rollers fastened together in a movable frame, forming a so-called anti-friction bearing, have been put on the market, but none are used very extensively.

When a car bears hard on the side bearings all the shocks caused by imperfections of the track are transmitted to the body and the car rides hard. To prevent this, and at the same time have a close adjustment between body and truck, side bearings are in use on some cars, especially for live stock, in which the lower bearing is forced upward by means of special springs inclosed in a case.

Center Pin.

The center pin (*P*, Fig. 3,) is a bar of round wrought iron, generally from $1\frac{1}{2}$ to 2 inches in diameter, which passes through the body and truck center plates and bolsters and holds these parts in their relative position in case the plates should become broken or the body of the car be raised high enough for the center plates to disengage themselves. The pin is also a guide when putting the body on the trucks and is usually put in place before the body is let down.

Center pins are sometimes made with heads resting either on top of the body-bolster or in cast-iron sockets let into the floor; this, however, is not a desirable plan, as the

cars, and from $2\frac{1}{2}$ to 3 inches on cars on where heavy materials such as coal, ore, stone, etc., are carried.

(To be Continued.)

The Solignac Mixed Boiler.

This boiler, as it is now built, varies very widely from the original one as it was first put upon the market. Like all new inventions, it has been subjected to successive transformations, based upon the very legitimate desire of satisfying all of the practical requirements that may be made upon it, and of taking advantage of everything that experience may have suggested. In its present form, however, it seems to have reached this goal, so that it is deserving of a careful examination, as being among that class of generators in which the production of steam is very high. The inventor, M. Solignac, calls it a mixed boiler because it partakes, at the same time, of the characteristics of those boilers carrying a large volume of water and of those composed of elements intended for the instantaneous generation of steam.

These two conditions, each of which would seem to necessarily exclude the other, could only have been harmonized with the greatest difficulty by the ordinary means, and it has only been by boldly turning aside from the beaten pathways that M. Solignac has been able to attain the results that he has

We know that the free production of steam in multitubular boilers is intimately connected with the rapid renewal or circulation of water in the tubes; then, as it is a poor conductor of heat, it is quite natural that, in its course through the tubes, that portion which comes in direct contact with the metal should be heated more than that lying in the center and forming the core, as it were. Whence we see the necessity of giving the water the highest possible speed of flow in order to protect the tubes from an excessive temperature, and consequently reaching a coefficient that is too high for the proper transmission of heat. Again, even though the tubes may be perfectly free to expand, the greater or less activity in the circulation of the water none the less limits the intensity of the fire within bounds which it would not be prudent to exceed unless we are willing to expose ourselves to the dangers of a bursting tube—an accident that is especially liable to occur when running under a forced draft.

From the present view of the case, the circulation is caused by the ascension of the globules of steam, and this creates a difference of pressure between the top and bottom portions of the boiler that tends to check the circulation. But in spite of this detrimental influence, and in spite of the sudden changes in the direction of flow, the fact remains that the water does have a comparatively rapid rate of flow, one engineer of high authority estimating it to be about 16½ feet per second, corresponding to about 200 circuits of the water before it is finally transformed into steam. Is it possible, then, to expect an increase in the speed of circulation, and consequently an increase in the amount of water evaporated per square foot of heating surface, from the mere fact alone that there is a better opportunity afforded for the liberation of the steam? In the opinion of M Solignac, the maximum has been nearly reached in this direction, so he has abandoned the beaten tracks and sought a radical solution of the problem. His researches have led him to dispense with the natural circulation due to the disengagement of the steam, and to produce it with increased intensity by the forced injection into the evaporating elements of a stream of hot water taken from a reservoir that is under pressure and which is not in contact with the gases of combustion, and which in itself forms a steam drum.

Under the influence of the expansion at the outlet of the nozzles used for this forced injection, the water is thrown into the tubes in so fine a spray that its particles take no part in the convection of heat to one another; but, possessing as they do nearly all of the heat that is required for their complete evaporation, these particles come successively in contact with the metal of the tubes at a high velocity, and this is exactly the conditi n that insures a very high coefficient in the transmission of heat. Thus the spray is evaporated as it advances through the tubes and leaves them in the form of dry steam, and enters the reservoir or drum that is under pressure and from which the injection water is taken.

Contrary to the usual practice, this steam does not rise into the dome of the drum, but enters the body of water where it drops to a temperature corresponding to the pressure. At the same time the steam is liberated from the upper surface of the water more or less abundantly, according to the absorption of heat by the cold feed-water and the generation of the steam, leaving a greater or less amount of heat available for the latent heat of evaporation.

It is an interesting fact that by suddenly heating the cold feed water in this reservoir the greater portion of the impurities contained therein is precipitated, and such salts as escape this first precipitation cannot lodge in tubes, for they are driven out by the strength of the current.

We may admit, as a basis for the construction of this boiler, that the steam which is sent into the water reservoir is entirely condensed, so that, in order to compensate for the consumption of heat due to the evaporation of 100 pounds of cold water, for example, it is necessary that it should give up all of its heat to the same weight of steam. Starting from the principle of instantaneous evaporation, M Solignac might have adopted a section of tube that was just sufficient for the flow of this quantity of steam; but in order to have an ample margin outside of his calculations, he has adopted a section that is considerably larger. Under these conditions he has obtained 100 kilogrammes of steam per square meter (20.46 pounds per square foot) of heating surface with an internal diameter of tube that has been invariably fixed at .95 inch and an efficiency of 8 pounds of steam per pound of coal; so that the boiler is very much smaller than the ordinary one of the same capacity, as can be seen from an examination of the dim nsions given in the illustration, which represents a boiler capable of generating 1,100 pounds of steam per hour.

We have at A a water drum that is under pressure and away from the fire; it is put in communication with the collector H in front of the nest of tubes B by means of the valve casing C. At the back end each tube is provided with an injection nozzle, and is expanded into the shell of a collector, D, into which the delivery from the circulating pump I is led by means of the pipe F. This pump is in communication with the reservoir A through the pipe J, and is a direct-acting Blake pump, as shown in the sections (figs 5 and 6). Steam is furnished to the motor cylinder by the pipe E that leads off from the steam space. The circulating pump is driven by side connections coupled directly to the piston rod, which is in line with the plunger of the feed pump K; the latter drawing water from any convenient source of supply and delivering it into the reservoir A through the pipe L, that is provided with a suitable check valve. The following are the principal dimensions of the pumps:

Feed.

Diameter of piston	2.17 inches
Stroke	3.94 inches.
Delivery per hour	211 gallons.

Circulating.

Diameter of piston	2.95 inches.
Stroke	3.94 inches.
Theoretical delivery per hour	423 gallons.

We thus see that the circulating pump has a delivery far above the theoretical volume on account of the temperature of the mixture that flows into it, as a matter of fact, its delivery is 1,100 pounds of water.

At the front and in a horizontal position we find an apparatus called a commutator, which plays a double *rôle*; it permits the reheating of the water while under pressure, and in doing so it automatically prevents the tubes from being deprived of water should the pump cease to act. This commutator (Figs. 3 and 4) consists of two differential pistons, m and n, that move in independent cylinders placed in a line with each other; the plunger m, at the left, receives through the pipe I the pressure normally existing in the feed pipe L (Fig. 2); as for the the piston n, its front face is in communication through the pipe O with the collector D at the back end of the nest of tubes.

When in its normal position the piston n covers the opening G of a pipe leading to a cock mounted upon the reservoir A below the water level; further, an obturator, p, solidly fastened to the large piston, closes the pipe, P, which directly connects the steam space of the reservoir with the collector H in front of the nest of tubes.

It is now easy to understand how the operations are effected.

When the reservoir A is provided with the proper quantity of water, the stem q of the commutator is pushed by hand, so that the two pistons, m and n, and the obturator, p, are at their position to the extreme left. Then the water flows from the reservoir, A, into the collector, D, and passes through the tubes; the steam produced rises and escapes by the pipe P to the top of the body of liquid. The temperature of this latter gradually rises, and when it corresponds to a pressure of 14 pounds per square inch the Blake pump is started; straightway the pressure due to its delivery is exerted upon the plunger m, which is thus driven to the right and pushes the piston n in the same direction until it strikes against the stop made for it in its own cylinder. In this position the piston interrupts the direct flow of water from G into O, and the obturator p closes the pipe P. At the same time the circulating pump I receives a supply of hot water from the reservoir through J, and delivers it through F into the back collector D, whence it is forced through the nozzles that spray it into the evaporating tubes B. Starting from this point, the production of steam becomes intense; the pressure in the reservoir increases very rapidly, it being at the rate of about 14 pounds per square inch per minute, so that all of the water soon reaches the temperature corresponding to the existing pressure

We obtain this pressure more or less rapidly, according to the amount of water that is pumped into the reservoir A at the beginning, and if, to hasten it the reservoir has not been filled to its proper level, it can be raised by running the pump. A pipe, R, connects the steam dome with the front collector H in such a way as to insure the latter being always kept free from water.

As steam is drawn off from above the plane of evaporation, the body of water furnishes a renewed supply, thanks to the heat carried into it by the steam, which, issuing from the valve C enters the mass; and in order to secure the b es possible conditions of mixture, a sort of trumpet with circumferential holes has been placed above the valve C, which insures the thorough commingling of the steam that is generated in the tubes with the water

On account of the arrangements used, the plane of water from which evaporation takes place has a large surface that is always calm, which, coupled with the spacious volume of the reservoir, is very favorable to the production of dry steam.

If, while the boiler is at work, the pump should be accidentally stopped, the load due to the pressure in the delivery on the plunger m of the commutator disappears, and as the pressure existing in the collector D of the tubes continues to be exerted upon the piston n, the latter is driven to the left, carrying the plunger m with it, and the boiler continues its action with a feed from a direct flow of water. Then the stem or bridle q, which previously stood opposite the word "Pump" (Fig. 3), comes to be opposite the word "Direct" so that the fireman is notified that the commutator is in operation. In an installation now in course of erection this notification is completed by an audible signal in the form of a whistle that is blown by the bridle q as it starts in the movement to the left.

This boiler possesses numerous advantages. First is its safety; in this respect the rupture of a tube would have no other effect in normal working than to cause the valve C to close, and only that small amount of steam that was contained in the nest of tubes at the time could escape into the firebox; and furthermore all the joints of the tubes are away from contact with the fire.

In the second place, the size and weight of the boiler is greatly reduced on account of the small dimensions of the heating surface, furthermore, the flexibility of the power of this boiler is so great that it is possible, without any fear of overheating, even with a forced draft, to give dimensions to the reservoir corresponding to the rating of the boiler, and if there is a shortness of water due to the draft made upon the steam, a defect in the feed will have no serious consequences, because the reservoir is not in contact with the fire.

As for economy, this boiler has shown itself to be economical from the threefold standpoint of first cost, maintenance and consumption of fuel.

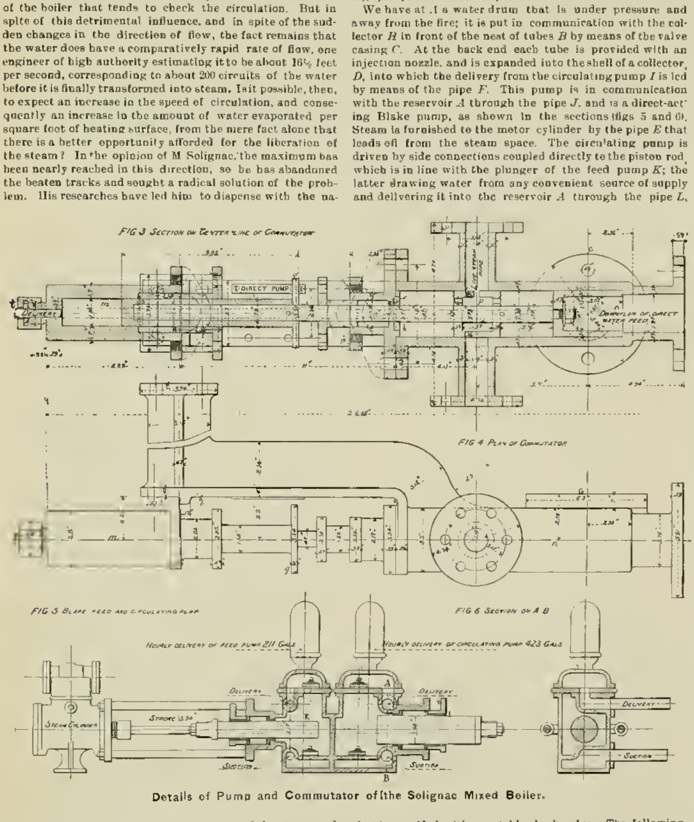
To show the saving in first cost which is the direct result of cutting down the heating surface, we give below some dimensions of two types, one having a capacity of 1,100 pounds and the other of 6,600 pounds per hour:

	1,100 lbs.	6,600 lbs
Grate area	10 76 sq. ft.	51 66 sq. ft.
Heating surface	129.15 sq ft.	644 33 sq ft.
Normal volume of water	74 5 gals	358 gals.
Total capacity of boiler	141 34 gals	671 gals.
Number of tubes	82	300
Length of tubes	5 ft. 1.42 in.	6 ft. 10 68 in.
External diameter of tubes	1.18 in.	1 18 in.
Thickness of tubes	.12 in.	12 in.
Steam pressure (lbs per sq in.)	62½	62½

As for the economy of maintenance, it is due to the simplicity of the boiler and the efficiency with which the tubes are kept cool, these being, as we have said, always of a dead black color while the boiler is at work, showing the rapidity of the absorption of the heat of the firebox, and, besides this, all of the elements are interchangeable, even between boilers of different powers. Finally, in order to show exactly what has been done, we cannot do better than publish the results of some experiments that have been made with this boiler They are as follows:

Grate area	10.76 square feet
Heating surface	65.6 square feet
Number of tubes	30
Natural draf	
Pressure in pounds per square inch	71
Temperature of feed-water	41 degrees F.
Water evaporated per hour	1,130 pounds.
Coal burned (gross weight)	166 pounds.
Ashes	16.5 pounds.
Coal burned (net)	149.5 pounds.
Water evaporated per square foot of heating surface	21.8 pounds.
" " " pound of coal consumed	8.61 pounds
" " " " " " burned	9.56 pounds.

Mr. Elias B. Dunn, head of the weather bureau at New York, has devised a system of electrical signals for railroads which consists of a series of red lights at short distances and frequent switches which, in case of accident, are operated to cut in the line of signal lights. The idea at present has been especially arranged for the requirements of the Brooklyn Bridge.



Details of Pump and Commutator of the Solignac Mixed Boiler.

(Established 1832.)

AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

27TH YEAR. 65TH YEAR.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 25th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

At the annual convention of the Master Car Builders' Association held last June, a resolution was adopted, to the effect that the different railroad clubs be requested to each appoint a committee of three representative members of the association, the joint committee so appointed, to take into consideration the general remodeling of the M. C. B. rules of interchange. That committee has just published its report, which has been sent to members of the association and will doubtless call out a great deal of discussion. The committee has gone into the subject very fully, especially into the defects of standard couplers, and their report makes a pamphlet of 26 pages. Thus gradually, year by year, a system of law for the operation of railroads is being evolved and it seems probable that there will be a mechanical Blackstone, and a Kent's commentaries on cars, before very long.

New York City is to have an electrical exhibition, commencing on May 4 next and continuing until June 1. The exhibition is to be held under the auspices of the National Electric Light Association in connection with its nineteenth convention, and promises to be the largest and most interesting display of electrical apparatus of all kinds ever made in this country. The exhibition will be held in the great Industrial Building, which occupies the entire block on Lexington avenue between Forty-third and Forty-fourth streets. Many novel and unique features in electrical displays will be introduced in connection with the exhibition. There will be given a series of popular and practical lectures on electrical subjects by eminent scientists, also afternoon and evening concerts by famous military bands, and special spectacular effects, all of which will be open to the general public. Mr. Clarence E. Stump has been appointed General Manager of the exhibition.

London *Truth* says that the following notice is stuck up in all the tramway cars of Belfast, Ireland:

The habit of spitting in a public conveyance is a filthy one, and renders the person so offending subject to the disgust and loathing of his fellow-passengers.

Commenting on this the New York *Evening Post* says: "Now, why cannot the Manhattan Elevated and the Metropolitan Traction Companies stick up something of the same sort in large type in their cars? It would offend no one and it would probably stop the spitting of large numbers who have never before heard any objection to it."

We say amen to the *Post's* suggestion and will go still farther and recommend that such a notice should be conspicuously posted in every station and railroad car for the conveyance of passengers in the country. Colonel Hain is disposed to be a reformer and a public benefactor. He could earn the everlasting gratitude of all the ladies who travel on his road, if he would adopt the *Post's* proposal and thus lessen the unspeakably nauseous, execrable, offensive, odious, loathsome, horrible, hateful, detestable, foul, unwholesome, beastly, and infectious practice of expectorating in public places. "We" are not a woman nor the husband of one, and therefore can perhaps only faintly realize the disgust to which they must be subjected by having their skirts soiled from the pollution of public conveyances by those who convert them into swineries. Perhaps we ought to apologize to the pigs for the latter comparison, as we never heard of a hog spitting, excepting one of the human kind.

Since the above was written the "pathologist" of the Board of Health of New York presented to that body a report on the spitting habit and its danger to public health. In this report it is said:

"We desire to direct your attention anew to the continual transmission of infectious disease in public places, through the expectoration of persons suffering with different forms of infectious diseases of the throat and lungs."

The adoption of the following among other resolutions is recommended:

WHEREAS, spitting in public places constitutes a public nuisance; therefore be it

Resolved, That notices be posted in all public places and in all surface and elevated cars in this city, signed by the Board of Health, warning passengers against expectoration upon the floors of these conveyances; and, further, that similar notices be posted in the stations of the elevated roads, warning against expectoration upon the platforms and stairs or on the floors of the stations.

Resolved, That similar notices be posted in the halls and assembly rooms of all municipal and federal buildings in the city.

Resolved, That the municipal authorities be requested to provide sufficient and proper receptacles for expectoration for such public places as are in their control, and that the managers of the elevated roads be required to provide similar receptacles sufficient in number for their stations and platforms, and that in all cases these receptacles shall be kept in a cleanly condition.

Resolved, That the officers of the Manhattan Elevated Road be requested to give peremptory orders to their guards to refrain from and to prevent, as far as is possible, expectoration from the trains into the streets, and to secure the enforcement of these orders.

The editor of this paper regrets that the practice of chewing gum was not included in the animadversions of our friend the pathologist.

LARGE LOCOMOTIVE GRATES VERSUS SMALL ONES.

At the October meeting of the Western Railroad Club a paper, by Mr. J. Snowden Bell, on Wide Firebox Locomotive Boilers, was read and was afterward discussed at the November meeting. The paper was largely historical in its character, and described the different forms of wide fireboxes which have been introduced during the past 50 years. Considering the fact that various forms of large fireboxes have been in use for so long a time it is somewhat remarkable that such elementary propositions as the relative merits of large and small grates should still be the main topic of discussion, when this subject is brought before an up-to-date association like the Western Railroad Club. In fact the discussion was by no means conclusive with reference to the primary question whether a large locomotive grate and firebox is better than a small one. In fact this debate reminds one of a boy's composition on the seasons, in which he said that "some loves Spring, some loves Summer, others Autumn and others Winter; but as for me give me Liberty or give me Death." That is, the participants in the discussion seemed to desire most to maintain a non-committal attitude: with reference to the question under consideration, so as to be free to use big or little fireboxes as they might choose. Now, in this as in a great many other instances in life, we must be governed by the necessities and not the utilities which control the problem. In locomotive practice a prime necessity which transcends all others—excepting perhaps that of safety to life and limb—is that a locomotive should generate enough steam to meet the maximum demands of its service. That is it must make steam enough to be able to pull the train, or make time, up the ruling grade in good and bad weather. Nearly or quite everything else must be sacrificed to this necessity. Economy is almost entirely subordinate to it. As a corrollary to this the inference may be drawn that grates should be big enough to burn as much coal as is required to meet the demand of steam at such critical times. If the grate is smaller than this it will limit or reduce the capacity of the locomotive, and to do so will be more costly than to waste coal. In other words, the minimum size of the grate is limited by the maximum capacity of the engine.

On the other hand, more than forty years ago D. K. Clark, in his treatise on Railway Machinery, enunciated the principle that "the larger the grate the smaller is the economical consumption, *even with the same heating surface*, showing that the economic value of heating surface is reduced by increasing the grate." From this he drew the inference that "there may be too much grate-area for economical evaporation, but there cannot be too little, so long as the required rate of combustion does not exceed the limits to be afterward defined." Again, as though to emphasize this principle, he says: "The maximum economical hourly consumption increases directly as the grate-area is reduced, even with the same heating surface; showing that *the economic value of heating surface is increased by reducing the grate*,* and that by this simple expedient, the same heating surface can economically evaporate larger quantities of water per hour." Again the same author says: "As the economic value of heating surface depends so much on the grate-area, being less as the area is greater, *the grate should be kept as small as is consistent with the demands for steam*,* and the practicable rate of combustion." A discussion by the Western Railroad Club—or better still by the Master Mechanics' Association—of these principles, enunciated by Clark so long ago, would now be very interesting. Are they true or is there any doubt about them? If there is it would be of the utmost importance to railroad companies that the true principle with reference to the proportions of locomotive grates and fireboxes should be ascertained, which could be readily done through a series of not expensive experiments if made by an intelligent person. Unfortunately most of our railroad managers seem to be wedded, or at least in love, with ignorance. They are always ready to spend any amount of money in contention or litigation, to protect themselves and advance their interests, but if it could be known, it is believed that the amount of money which is expended annually for the advancement of knowledge is very small.

In the discussion of the paper Mr. Barnes asserted somewhat confidently that "the experiments made on ocean steamers show so conclusively that a high rate of combustion is accompanied by loss in efficiency, that it does not seem that any one conversant with the facts could dispute the value of a large grate." Again, he said, "We have a great many experiments on locomotives in this country which show conclusively that locomotive boilers with large grates are more efficient than those with small grates, when boilers of equal shell diameter are doing the same work." This statement is just the reverse of Clark's conclusions. Which is right? Continuing the discussion, Mr. Barnes said: "A strong draft reduces the efficiency when a boiler is so much forced as locomotive boilers are. In stationary boilers, when the draft is very light, an increase of the draft sometimes brings greater efficiency; but when the draft is increased to anything like locomotive draft a farther increase brings less." He said further that what he "wished to emphasize is that, when fuel used per square foot of grate per hour is more than 150 pounds, the use of a larger grate will give a substantial saving." This leads to the query, "What is the most economical rate of combustion?" The maximum now is about 200. When that rate is attained the mean would probably be about 100. If now we could ascertain the most economical rate, would it be best to adopt it as a maximum, or an average rate of combustion? It may be that while a rate of 200 pounds per square foot per hour is wasteful, when the engine is working at its maximum capacity, that a grate proportioned for that rate working under such conditions would give the most economical *average* results.

Mr. Barnes could do no better service than to collate the experiments bearing upon this question and then analyze them and indicate their significance. Probably his confidence in the soundness of the propositions he enunciated would be a little shaken if all the evidence was collected and carefully weighed. It may be remarked incidentally that the interesting experiments which were made by John E. Martin in Chili, a report of which is published in the Proceedings of the Master Mechanics' Association for 1878, sustains Clark's views. Away back in the fifties Ross Winans was building his Camel engines with what were then considered very long and wide fireboxes for the Baltimore & Ohio Railroad. Samuel J. Hayes was then Master of Machinery and designed some ten-wheeled engines with fireboxes as wide as he could get between the wheels and rise flat slab frames on their sides. The grates were not as long as Winans' and part of them were covered with dead-plates. In a test of fuel consumption Hayes' engines beat Winans', and the latter then resorted to the use of dead-plates and obtained better results. Afterward, when Hayes became the Superintendent of Machinery of the Illinois Central Railroad, he equipped nearly all the Rogers and other engines in that line with what were called hopper grates; that is, there were inclined dead-plates in the sides and in the back, and the drop-door in front was also dead. These grates produced very good results with the inferior Illinois coal. When Mr. Wootten first tried one of his fireboxes for burning bituminous coal he left the whole immense grate open, but soon discovered that he could produce better results by covering part of it with firebrick.

There seems to be a good deal of evidence to sustain the principle enunciated by Clark, that the smaller the grate, provided enough coal can be burned in it, the greater the economy. Of course a rate of consumption of coal may be reached, with a powerful blast, at which much of the fuel is not burned but is lifted mechanically from the fire carried through the tubes and up the chimney. That such a rate is not economical need hardly be proved, but such a maximum rate of consumption may be required in order to have the most economical average rate when the locomotive is not working the hardest.

Investigation and experiment would probably show that some given rate of combustion per square foot of grate per hour is the most economical, or possibly that different rates are desirable according to whether the locomotive is

*The italics are ours.

working hard or not. From this the inference may be drawn, that the open grate should be larger when the engine is doing its maximum work, than it is during an average or minimum exertion of power. In other words to produce the best results the area of open grate should be variable, to meet the requirements of the work to be done.

But in the consideration of the size of fireboxes and grates the fact is often lost sight of that there are really two questions involved, one concerning the area of the grate, and the other that of the volume or contents of the firebox, and that a *large* firebox may be used with a *small* grate, and if it can be shown, as Clark enunciated, that small grates are more economical than large ones, it does not follow that the fireboxes should also be small. A big fire box in combination with a small grate may be, and probably is more economical than a small firebox would be. There can be no doubt that the process of combustion occupies an appreciable amount of time, and it is also true that, with a powerful blast and a small firebox, that the movement of the air and gases in the firebox and tubes is very rapid. Probably when an ordinary locomotive is working hard not less than 250 cubic feet of air and gas is exhausted from the firebox in a second. As the cubical content of an ordinary locomotive furnace is only about half that volume, the air and gases in it must be changed twice during each second, so that whatever combustion occurs, must take place in half a second. If the size or volume of the firebox was doubled the air and gases would remain in it twice as long, and, conversely, there would be twice as much time for combustion to take place. It seems evident that under these conditions, better combustion would result than can be secured when less time is given for it to take place. The inference may then be drawn that the larger the firebox the more likely we are to secure good combustion, and if D. K. Clark is right about grates we must come to the apparently contradictory conclusion that the smaller the grate and the larger the firebox the better will the combustion be.

But there is another principle involved. Frederick Siemens long ago pointed out that as soon as flame comes in contact with any solid substance combustion is at once retarded, and it begins to smoke. This may be shown by holding a metal or glass rod in the flame of an ordinary gaslight. Siemens' inference from this was, that in all kinds of furnaces we should aim to keep the flame away from the sides and top as long as possible, or until the process of combustion is completed. This principle has been observed in the construction of ordinary egg-shaped stoves for burning bituminous coal and in foundry cupolas and blast furnaces, in all of which there is a small grate at the bottom and the sides then swell out above so as to be away from the flame as it rises from the fuel. Owing to the construction of ordinary locomotive fireboxes, and the limits to which they are confined, this principle could not be adopted and the sides are so placed—especially in those which are very narrow—that the flame comes in direct contact with the plates, which have water on the opposite side of them. By the use of wide fireboxes and contracted grates, the contact of the flame would not be so immediate nor direct as it necessarily must be with a narrow furnace. The ideal form for a firebox would be a hollow sphere, a form which has the least area of enclosing surfaces, in proportion to the internal space of any other. A sphere, however, would not be a convenient form for a firebox. If it is to be rectangular, a cube would have the least surface area of any other form, or in other words the nearer the width, length and height are to being alike the better.

If the preceding reasoning is sound, we will have the conclusion that the smaller the area of the open grate of a locomotive, provided enough coal can be burned on it, the greater the economy, and the larger and more nearly alike all the dimensions—that is its length, breadth and height—of a firebox are the better. Now these propositions are of very great importance to railroad companies. At present they are to a considerable extent merely tentative, and to be entirely convincing some experimental demonstration is required. It is believed that it would be immensely profitable to railroad companies if the required experimental investigation was made by some competent person to prove the soundness of these conclusions. Who will undertake to have it done?

Trade Catalogues.

[In 1891 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car-Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

STANDARDS.

For postal-card circulars	3¼ inches by 6¼ inches.
Pamphlets and trade catalogues	3½ inches by 6 inches. 6 inches by 9 inches. 9 inches by 12 inches.
Specifications and letter-paper	8¼ inches by 10¾ inches.

COMPUTERS PUBLISHED BY COX COMPUTER COMPANY, 173 Greenwich street, New York.

This is a circular describing several kinds of "computers" which consist of circular card discs arranged to revolve in a foundation plate and with printed scales corresponding to the various factors of the formula. In the circular before us computers for pulleys and gearing, belting and shafting are described. The company makes some 30 others for various purposes which they propose to furnish for advertising and other purposes.

A THIRD OF A CENTURY OF PROGRESS. Being a Brief History of the Development of the B. F. Sturtevant Company, Boston, Mass, 36 pages, 5 by 6¾ inches. (Not standard size).

The title of this little publication describes its character accurately. It is a brief history of the company, illustrated first by a portrait of Mr. Sturtevant, the founder of the company, and further on with one of Mr. Foss, the present General Manager. Several views of the works as they appeared at different periods are also given, some of them made from excellent wash drawings. There are also scattered through the "history" small engravings representing various machines made by the company, but which are hardly worthy of very high commendation. The little volume gives, however, an excellent idea of the wonderful progress of the establishment, which was started by a young shoemaker within the recollection of many of us who are no longer young. The pamphlet is admirably printed on excellent paper.

THE NEWTON MACHINE TOOL WORKS, of Philadelphia, announce that they have removed to their new works at Twenty-fourth and Vine streets, and send a circular giving internal and external views of their new works and small illustrations showing the various kinds of machinists' tools which they manufacture.

THE NATIONAL MALLEABLE CASTINGS COMPANY, OF CLEVELAND, O. 113 pages, 9 by 12 inches. Standard size.

This latest catalogue of the company serves as a striking object lesson of the extent to which malleable iron is applied in car construction. The whole 113 pages are filled with well executed half-tone engravings in vignette illustrating the various articles for which the company has patterns. Each article is given a number and beneath it is printed a short description giving dimensions, etc., that may be of value to the purchaser. The last pages are occupied by a very complete index, so that any article can be easily found. The book is printed on heavy calendered paper, and is an example of fine presswork. Among the special articles to which attention is called are the Tower coupler, the National car-door fastener, center plate, journal box and journal box lid, the Eubank car door and fixtures, and Coffin's carline and sill pockets. For the rest the work includes pretty much all the metal work of a car.

THE NEW BRITAIN MACHINE COMPANY. *Manufacturers of Chain Saw Mortisers, Case Engines, etc.* New Britain, Conn. 12 pages, 6 by 9 inches. (Standard size.)

Probably a good many readers will be disposed to ask what a "chain saw mortiser" is? In reply it may be said that it is a wood-working machine in which, as described in the catalogue before us.

"The cutting is performed by a steel chain, each link of which has a sharpened tooth so formed as to carry away its own chip, and is presented to the work a thousand times a minute. This will illustrate the possibilities of the machine for rapid work.

"This chain, driven by a sprocket, travels over, and is guided by a chain-bar having an anti-friction bearing at its lower end. The table holding the work is fed automatically up towards the chain, the mortise, either "blind" or "through," is made at a single cut and the table rapidly descends to the starting point ready for another mortise so quickly as to almost limit the machine's output by the ability of the operator to supply it with work. Under ordinary circumstances, from 400 to 500 four panel doors should be put through in ten hours (each door having ten accurate, clean mortises), and other work in proportion, depending on the size of mortise and hardness of stock."

The machine is illustrated with very good wood engravings and its advantages are fully set forth. The chain which does the mortising is shown by a separate engraving, in its relations to a mortise in a wooden beam.

The Case steam engine is also illustrated, which is a self-contained vertical engine. It would be much more satisfactory if a sectional view showing the internal construction of this engine was given. It is announced in a slip enclosed with the catalogue that Mr. Sidney B. Whiteside, of 139 Liberty street, New York, is the selling agent for this company.

CATALOGUE NO. 4. THE WEIR FROG COMPANY, MANUFACTURERS OF FROGS, SWITCHES AND CROSSINGS. Cincinnati, O. 273 pages, 4½ by 8¼ inches. (Not standard size.)

This is another example of the many admirable catalogues which are now issued by our manufacturers of railroad material and appliances. The only faults which we can find with it is that it is not a standard size, and the other is that its usefulness would have been much increased if somewhat fuller elementary explanations had been given of the construction and appliances illustrated. That which is given is, however, so good that—like poor Oliver, in Dickens' immortal story—we are inclined to "ask for more."

The book opens with a sort of invocation to the "patrons" of the company, which is followed with "instructions for ordering material."

Frogs are the first structures which are illustrated and described, the opening portion of this department being an explanation of the methods heretofore employed for constructing frog-points and that now adopted by this company. A large number of frogs for various purposes and localities are then illustrated with excellent wax-process engravings showing plan and sectional views of the frogs. The second portion is devoted to crossings, which are similarly illustrated. This is followed by a chapter on switches, in which the various types are illustrated and described, and this is supplemented with descriptions of switch stands which are represented by some excellent wood engravings. Chairs, rail-braces bridge-guards, station signals, derailing switches, frogs and switches for light rails are all described and illustrated. Street railway track work has a separate department devoted to it, in which nearly all the appliances enumerated above, but which are adapted to that kind of service are shown and explained.

At the end of the book a series of admirable tables are given relating to track work. These include tables for the leads for turn outs, for crossovers, bills for crossties for turnouts, crossovers and crossings of various kinds, several giving the number of feet (board measure) in cross-ties, others in which the quantities of rails, angle-bars, spikes fish-plates and bolts required per mile of track are given. There are also tables of middle ordinates in inches for curving rails, decimal parts of an inch and a foot for each sixty-fourth of an inch, and a list of the weight and size of rail sections carried in stock by the Weir Frog Company.

The book is printed on good wood-pulp paper, is well bound and of convenient size and form, and is altogether worthy of commendation excepting that it is not of standard size.

MORISON SUSPENSION FURNACES FOR STATIONARY BOILERS. *Manufactured by the Continental Iron Works.* Brooklyn, N. Y. 25 pages, 9 by 11 inches. (Not standard size.)

The chief purpose of this publication is to describe corrugated iron furnaces, and set forth their advantages. The book opens with an excellent perspective view, made from a wash drawing of the Continental Iron Works. There is then a very good dissertation on internal furnace tubular boilers, with references to some excellent line engravings, showing sectional and other views of a "Scotch," a "Locomotive," or "Gun Boat" boiler provided with the internal corrugated furnaces. The relative advantages of such boilers compared with those of the water-tube type are discussed, and the arguments in favor of the "suspension furnaces" are fully set forth.

Half tone perspective views are given of a boiler of 125 horse-power with a single furnace, in use at the Eighteenth street station of the Consolidated Gas Company, in New York, and another of a battery of five similar boilers now at the Milburn Pumping Station of the Brooklyn City Water Works. There is also a full sized sectional view showing the form of the corrugations, and tables giving the working pressure and thickness of the Morison furnaces, and another table showing the method of calculating the power rating of internal furnace boilers.

The Morison patent furnace door is also a specialty of manufacture by this company, and is illustrated and described at the end of the Continental Company's very neat catalogue, the cover of which may be especially commanded for its very simple and pleasing design.

American Machinist.

In the first number of this year it is announced, in this widely-known journal, that the control of the paper has passed into the hands of Messrs. Sinclair & Hill, the proprietors of *Locomotive Engineering*. The form and size of it has been changed, and those who have been familiar with the appearance of the old paper will be obliged to become acquainted with their former friend in a new dress. Whether the dignity of the old paper is to be maintained or the style which has been characteristic of *Locomotive Engineering*, and which appears to be popular, is to be adopted in both is not yet apparent.

Circular of Inquiry on Freight-Car Doors and Attachments.

The following circular has been issued by the committee of the Master Car Builders' Association:

Your committee, appointed to report on the latest improvements and best practice in freight-car doors and attachments, requests that you will co-operate by replying as promptly as possible to the questions given below:

1. Give your experience and the results obtained from the use of the different freight-car doors in use on your road.
2. What style of door do you prefer—the overhead hung, the bottom hung, or other style hung door, and why?
3. What style of door or doors are standard on your line, and what are their advantages over other doors?

Please furnish blue prints, sketch or full description of your standard door or doors, including end doors and attachments, covering the following detail:

A. Size of doors and style of construction.
B. Style of hangers used.
C. Style and shape of rail and size of same.
D. Method of securing rail to body of car.
E. Locks and their attachments and method of application.
F. Stops, both front and back.
G. Brackets at bottom of door, including common brackets and special safety brackets, to prevent opening of door without breaking of seal.
H. Wedges, shoes, etc., used on bottom of door.
I. Description of any peculiar construction of bottom of door where it runs into brackets or on rail.
J. Description and name of any patent device in use in connection with door hangings or fastenings, not brought out by preceding questions.

Please forward replies to F. H. Soule, General Car Inspector, N. Y., N. H & H. R. R., New Haven, Conn., before February 20, 1896.

Personal.

Mr. Clarence F. Barker has been elected General Manager of the Cairo Short Line.

Mr. H. C. Landon has been appointed Chief Engineer of the Chicago, Peoria & St. Louis.

Mr. John D. Campbell has resigned as Master Mechanic of the Buffalo & Susquehanna Railroad.

Mr. Remsen Crawford, of Atlanta, Ga., has been appointed press agent for the Plant system.

Mr. J. C. Hennessey, Superintendent of the Missouri Pacific Terminals at Kansas City, has resigned.

Mr. W. C. Brown has been appointed General Manager of the Chicago, Burlington & Quincy Railroad.

Mr. H. A. Riggs, Chief Engineer of the Toledo, Ann Arbor & North Michigan Railroad, has resigned.

Mr. La Mott Ames, who has been Master Mechanic of the Beech Creek Railroad for a number of years, has resigned.

Mr. A. H. Thorpe has been appointed assistant to the General Manager and Purchasing Agent of the Ohio River Railroad.

Mr. F. C. Gates is acting as Purchasing Agent of the Wheeling & Lake Erie Railroad during the illness of Mr. F. S. Deal.

Mr. Samuel Irwin, Superintendent of the Car Department of the Missouri, Kansas & Texas Railroad, died Jan. 5, of apoplexy, at Sedalia, Mo.

Mr. John Warwich has been appointed Purchasing Agent of the railroads comprising the Seaboard Air Line, with headquarters at Portsmouth, Va.

Mr. A. H. McLeod, formerly General Freight Agent of the Cincinnati, Hamilton & Dayton Railroad, has been appointed Traffic Manager of that road.

Mr. Thomas Orchard, Master Car Builder in charge of the Carbondale, Pa., shops of the Delaware & Hudson Canal Co., died recently at the age of 76 years.

Mr. George W. Parker, President and General Manager of the St. Louis, Alton & Terre Haute Railroad, has resigned the latter office and retired from active service.

Mr. Seeley D. Dunn has been appointed Superintendent of the Owensboro & Nashville Division of the Louisville & Nashville Railroad, with headquarters at Russelville, Ky.

Mr. F. J. Cole, formerly Mechanical Engineer of the Baltimore & Ohio Railroad, has resigned and accepted the position of Chief Draughtsman with the Rogers Locomotive Company.

Mr. W. A. Garrott, Superintendent of the Terminal Association of St. Louis, has resigned in order to take the position of Superintendent of the Western division of the Wabash Railroad.

Mr. A. M. Tucker, formerly General Manager of the New York, Pennsylvania & Ohio Railroad and its leased lines, has been appointed General Agent of the New Erie Railroad Company, with headquarters at Clevelavd, O.

Mr. H. Delaney has been appointed Master Mechanic on the Philadelphia & Reading Railroad. His office will be Third and Berks streets, in Philadelphia, and he is to have charge of the Philadelphia and New York Division.

Mr. L. R. Pomeroy, who was recently of the firm of Coolbaugh & Pomeroy, announces that he has been appointed sales agent for the Cambria Iron Company and the Latrobe Steel Company, with an office at 33 Wall street, New York.

Mr. Carl W. McKinney, General Manager of the Lackawanna Iron and Steel Company, has resigned on account of ill health. He will be succeeded by Mr. Henry J. Wehman, the present General Superintendent and Chief Engineer of the company.

Mr. Andrew F. Burleigh has been made sole receiver for the Northern Pacific Railroad by Judge Gilbert, of the United States Court at Portland. Judge Gilbert said a change was necessary, not for any personal reason concerning present receivers, but for more harmonious management of the road.

Mr. William Duncan, Traffic Manager of the Baltimore & Ohio Southwestern, has resigned that position, to take effect on Feb. 1. Mr. Duncan has been in active railway service for nearly 30 years, and will retire from railway work, but will become President of the Ludlow & Saylor Wire Company, of St. Louis, Mo., a concern in which he is largely interested.

Mr. Stephen C. Mason, Assistant Statistician of the Interstate Commerce Commission, has resigned to accept a responsible position with the McConway & Torley Company, of Pittsburgh, Pa. Mr. Mason has been connected with the Commission over eight years, and for the last three years in direct charge of the statistical division and of the compilation of the statistical reports published by the Commission.

Mr. Thomas Prosser, Sr., for more than 40 years a member of the firm of Thomas Prosser & Son, the American representative of the Krupp works in Germany, died on Jan. 10, at his home in Brooklyn, after a long illness. It is nearly a year since he has been engaged in active work. He was born in Worcester, England, 67 years ago and came to this county with his parents when he was nine years old. His father was engaged in the steel business in Paterson, N. J. In 1851 the father organized the firm of Thomas Prosser & Son, and commenced business in Platt street, near Gold, New York. While at the International Exposition in London in 1852 he met Herr Krupp, the founder of the Krupp works, with whom he formed a lasting friendship. He became the American representative of this firm and the business relations thus established have continued uninterruptedly to the present time. Thomas Prosser & Son have dealt mainly with railroads, steamship companies and machinery manufacturers. It is expected that Mr. Thomas Prosser, who has been connected with the firm for a number of years, will succeed his father as the head of the house.

Mr. Alfred E. Beach, who has been one of the editors and proprietors of the *Scientific American* for nearly fifty years, died on Jan. 1, at the age of 70, at his home in New York. He was the son of Moses J. Beach, the founder of the New York *Sun*, but, with the exception of a short period passed in his father's office, his entire business life has been spent as a member of the firm of Munn & Co., the solicitors of patents, which he established in 1846 with A. D. Munn. His firm bought the *Scientific American* and Mr. Beach became its editor, having been responsible for this department during all of these years. Outside of his work in the firm as a patent solicitor and editor, he devoted a considerable portion of his time to the development of his own mechanical ideas, and the list of his inventions is an important one. As early as 1852 he exhibited a type writing machine at the Crystal Palace Exhibition in New York, for which he received a gold medal. It had practically all of the devices of the typewriting machines of to-day. He devised a pneumatic tube system for carrying the mails and a pnematic railroad, of which an elevated experimental section was built. The Beach Pneumatic Transit Company, of which Mr. Beach was President, built a section of underground road beneath Broadway in 1869. This section was built without interfering with the street traffic by the Beach hydraulic shield, the parent of those used at the St. Clair tunnel, on the City & South London Underground Railroad, and elsewhere.

Queen Victoria's Cars.

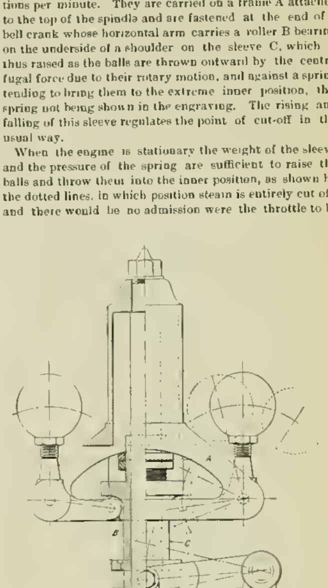
The official *Railway Gazette* states that the two railway carriages which the queen uses on her continental journeys were built for Her Majesty in Belgium, and they are her own private property. They are kept, when not in use, at Brussels, at the Gare du Nord, and have just been thoroughly overhauled and renovated. They are always carefully covered up to preserve them from injury. The day saloon is furnished with two sofas, two armchairs, one large footstool, all covered with blue silk, with yellow fringe and tassels. The walls are hung with blue silk for the dado, and pearl gray above, brocaded in pale yellow with the rose, shamrock and thistle. The curtains are blue and white, and a dark Indian carpet covers the floor. There is a large center table and two small ones. The ventilator in the center of the ceiling is of cut glass, and there are four lights in the ceiling. The carriage is lighted at night by four oil lamps fixed in brackets on the walls while shaded reading lamps are also used. There are electric bells, and one of the Highland attendants travels in a separate small compartment in front of the saloon. A short covered corridor connects the day saloon with the sleeping carriage, which is divided into a suite of small rooms. The dressing room, which is hung in Japanese style, with bamboo on the floor, contains a white metal bath and a washstand stand covered with red morocco leather. All the toilet articles are of the same metal as the bath. The bedroom is decorated in gray and brown. There is a large bed for the queen and a smaller one for Princess Beatrice, both of which were manufactured in the royal stores at Windsor, and all the bedding is bought fresh for each journey, and taken away afterward. There is also a luggage room, in which the two maids sleep on sofas.

A High Speed Belt Governor for Corliss Engines.

The close adjustment to speed that engine builders have been compelled to guarantee for electrical work has brought about a marked improvement in the regulating apparatus of all engines both high and low speed. While the high speed engines have been brought to a very close regulation with comparative ease, the difficulties have been greater with the low, owing to the longer period required for the performance of a complete cycle. In order to obviate this last difficulty, the Lane & Bodley Company of Cincinnati, O., have adopted a high speed governor for the regulation of their Corliss type of engines. This governor is shown in some detail by the accompanying engraving of half elevation and section, and was used on the 22-inch by 48-inch engine that was exhibited by them at the Atlanta Exposition, and whereon the regulation was so close that in the driving of the general electric monocyclic generator there was never a variation of more than one volt in the generation of a current averaging 107 volts.

This governor is driven by the usual belt and bevel gearing connection, the balls being run at a speed of 198 revolutions per minute. They are carried on a frame A attached to the top of the spindle and are fastened at the end of a bell crank whose horizontal arm carries a roller B bearing on the underside of a shoulder on the sleeve C, which is thus raised as the balls are thrown outward by the centrifugal force due to their rotary motion, and against a spring tending to bring them to the extreme inner position, this spring not being shown in the engraving. The rising and falling of this sleeve regulates the point of cut-off in the usual way.

When the engine is stationary the weight of the sleeve and the pressure of the spring are sufficient to raise the balls and throw them into the inner position, as shown by the dotted lines, in which position steam is entirely cut off, and there would be no admission were the throttle to be



High-Speed Belt Governor for Corliss Engines.

opened. To facilitate starting, the sleeve is slightly raised and the stop D so set that it is blocked up and the starting bar used in the ordinary way. As the engine gathers speed the stop drops out and the sleeve is held in suspension by the action of the balls. But if the governor belt should, at any time, break, fly off, become loose or otherwise inoperative and the balls stop, the sleeve at once drops to the lowest position and cuts off all steam admission to the cylinder.

Thus the rapid motion of the balls enables a close adjustment to speed to be maintained, while any accident to the apparatus itself causes the steam to be shut off and all damage from racing prevented.

A statement that worm gearing, if used for power transmission in electrical works, should be employed only in conjunction with low-speed motors, has brought out a remark from Herr E. Kolben, of the Oerlikon Engineering Works in Germany, that high-speed motors should be adopted in such cases if the best results are to obtained. He points out that a great prejudice against worm gearing has hitherto existed, on account of its having been regarded as an inefficient means of transmission. He believes that much depends upon the construction of the gearing and refers to tests recently carried out by Professor Stodola, of the Zurich Polytechnic, with the ordinary double-thread worm gear of the Oerlikon Engineering Works. The worm was 80 millimeters in diameter, had a multiple-ring bearing, and engaged with a worm wheel having 28 teeth, the wheel being of bronze, 373 millimeters in diameter. The whole of this gear was placed in oil in a cast-iron box. The gear was coupled to a 20 horse-power electric motor and the brake was applied on the worm wheel shaft. At 1,500 revolutions a useful performance of 21 horse-power was given on the brake, the efficiency amounting to 87 per cent. Herr Kolben is of the opinion that the efficiency with the motor fully loaded will increase even beyond 90 per cent., if the speed is high, the worm made of tool steel polished, the worm teeth of bronze, and the friction of the whole mechanism on the starting of motors at full load is reduced by having the pressure taken up by starting disks arranged on both ends of the worm.

The Most Advantageous Dimensions for Locomotive Exhaust-pipes and Smoke-stacks.*

BY INSPECTOR TROSKE.

(Continued from page 13.)

II. THE HANOVER EXPERIMENTS (1892-94).

These experiments were suggested by the fact that a newly constructed high-speed locomotive was an exceedingly poor steamer, and that the usual remedies made only a very slight improvement. In order to ascertain the reason for this phenomenon, Herr von Borries, the Superintendent of Motive Power of the State Railways, decided to make a special investigation with different shapes of smokestacks, and had made, for that purpose, the apparatus illustrated by Fig. 12. The author of this paper was intrusted with the execution of these investigations. They were commenced in the summer of 1892 at the main workshops of the

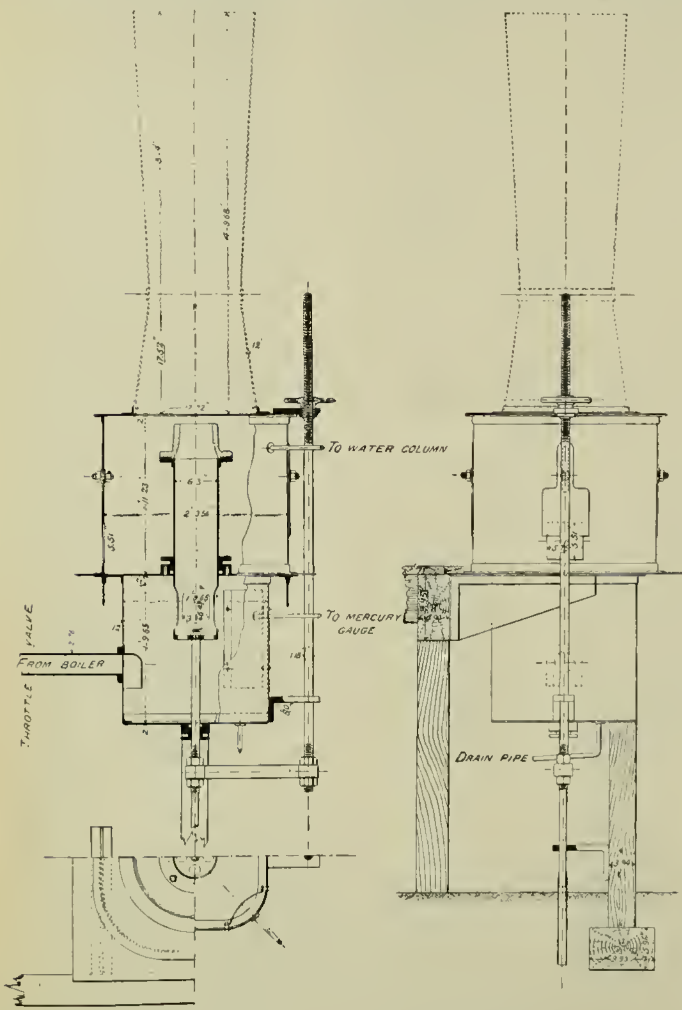


Fig. 12.—Apparatus Used in the Hanover Smoke-Stack Experiments.

railroad company, and continued on until the autumn of 1894.

The apparatus used is shown in Fig. 12. It consists essentially of a lower steam chamber and an upper air chamber. The steam pipe with a diameter of 6.3 in., passed air tight through the plate separating the two chambers and carried the nozzle at its upper end, this piece having an opening ranging from 3.9 in. to 5.5 in. The stacks subjected to the investigation had a diameter of 17.7 in., and were placed over the circular opening cut in the top sheet of the air chamber. On the four sides there were four air valves of the same size. It was the original intention to investigate the effect of various positions of the nozzle relatively to the lower end of the stack, and to do this by raising or lowering the nozzle through the means afforded by the apparatus illustrated in Fig. 12. But it developed that when the nozzle was in its lowest position, the air chamber itself acted as a sort of stack, and it became possible, with the stack removed, to obtain a vacuum equivalent to ¼ in. water pressure.

In order, therefore, to render exact work possible, and for which purpose it became necessary to place a cap over the mouth of the pipe leading from the boiler, the location had to be obtained by more convenient means. The distance of the nozzle in question could then be changed without actually altering the position of the nozzle itself, by changing the position of the stack by putting welded rings in between its foot and the air chamber. These rings were welded out of ¼-inch plates, and were of the form shown in Fig. 13. There were 10 of these rings, starting with one 1.57 inch in height and increasing in height by 1.57 inch. By setting several rings on top of one another, the distance of the nozzle from the lower end of the stack could be increased up to 30 inches or more.

During the tests the joints between the rings were well packed with wicking, so that they were kept air tight. The four air valves were so adjusted for the admission of the outer air that their combined free area amounted to 11.65 inches by 5.51 inches equals 80.72 square inches. This latter had previously been determined on a standard passenger locomotive in the following manner. After loosening the slide valve and then fastening in another in such a way that the steam ports were closed, a mercury manometer was connected with the empty steam chest of the locomotive and then enough steam was admitted through the throttle valve, the depth of the fire being the same as that ordinarily carried on fast runs, to produce a vacuum of 3.94 inches of water in the smoke-box as indicated by the water column attached thereto. The corresponding readings of the mercury manometer that measured the steam pressure were noted, and this was repeated several times until a whole series of results was obtained, and then an average was taken. Then a blast nozzle of the same size as that used upon the locomotive was placed upon the apparatus and steam admitted until the mercury manometer indicated the average pressure that had been obtained by the previous experiments, when the air valves were so adjusted, the same amount of opening being left in each, that the vacuum indicated by the water column amounted to 3.94 inches. This was then made the basis of the experiments which were thus warranted to correspond closely to actual practice. As a matter of fact also, as we have already remarked, the different shapes of stacks that were investigated with the valves in these positions were frequently transferred afterward to locomotives under steam and made fast, where precisely the same results were obtained. In consequence of the uniformity of results the slight difference which existed between the steam measurements in the steam-chest and the apparatus due to the greater freedom of steam flow in the latter seems to be a matter of no moment.

The position of the four air valves being thus ascertained,

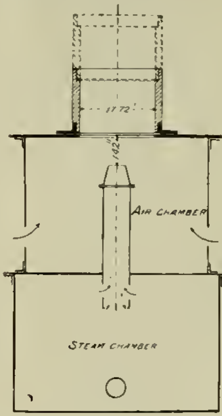


Fig. 13.

the experiments were then carried on, admitting cold air into the chamber, while in the actual work of a locomotive it is well known that the temperature of the hot gases coming from the firebox range from 575 degrees to 840 degrees Fahrenheit. Afterward similar experiments upon a running locomotive showed that the difference between the same shaped current of steam as applied in the apparatus or upon the standing locomotive and the steam acting intermittently upon a fast-running locomotive is of no importance whatever, as far as the action of the stack is concerned, and though this is not the case with slow-moving locomotives, it is in no way troublesome to make a transfer or application of the results obtained with the experimental apparatus. It has already been stated here that isolated experiments with the apparatus in no way serve to establish the formula for the laws of actual service, but that these can only be fixed by experiments with running locomotives.

The next thing to establish was how smokestacks of different forms would act with respect to the creation of the draft. Here it is a matter of slight importance whether the values of the vacuum obtained are in exact correspondence with the values observed on running locomotives or not.

In all the experiments with the apparatus the aforesaid positions of the air valves were left unchanged, hence the sucking action of the steam current could not be clearly shown for the different relationships, but only on locomotives of prescribed limitations. Moreover, though the experiments had already occupied so much time for the establishment of this basis, and though it was necessary for them to be carried on at spare intervals, it was very evident that they must be extended still further in order to investigate the effects of varying the size of the air openings. These experiments were made with blast nozzles of five different diameters and 18 different smoke-stacks taken from locomotives of ordinary proportions. The dimensions and shapes were:

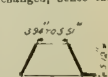


Fig. 14.

(a) Five different blast nozzles of 3.94 inches, 4.33 inches, 4.74 inches, 5.12 inches and 5.51 inches in diameter, as shown in Fig. 14.

(b) Five cylindrical stacks of 13.78 inches, 14.76 inches, 15.75 inches, 16.73 inches and 17.72 inches in diameter, as shown in Fig. 15.

(c) Conical-shaped stacks with converging top and bottom inclinations of $\frac{1}{12}$* and minimum diameters of .81 pinches, 12.8 inches, 13.78 inches, 14.76 inches and 15.75 inches, as shown in Fig. 16.

* Paper read before the German Society of Mechanical Engineers.

* By "inclination" the inclination of the two sides of the cone is meant; each side naturally has, therefore, but one half the above-stated inclination to the vertical. If the inclination of the stack is considered to be n, then one side of the cone will be $\frac{n}{2}$; if the length of the stack be considered to be equal to l, then the upper diameter of the stack will be $\frac{l}{n}$ greater than the smallest diameter. For example, if we have a stack 3 feet 6 inches long, with an inclination of $\frac{1}{12}$, we have an increase of diameter of $\frac{42}{12} = 3\frac{1}{2}$ inches, or with an inclination of $\frac{1}{6}$, an increase of $\frac{42}{6} = 7$ inches, etc.

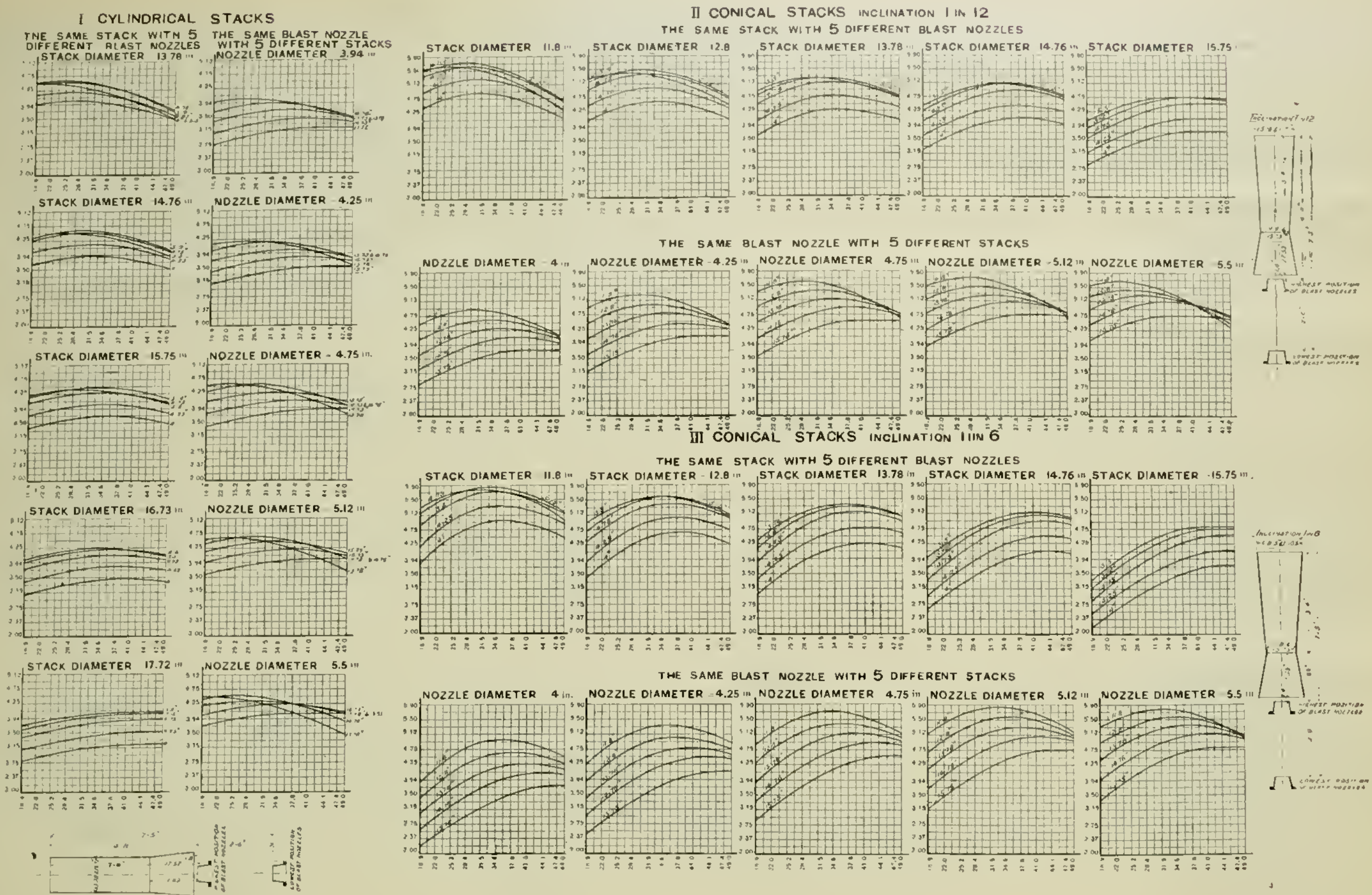


PLATE I.—DIAGRAMS OF RESULTS OBTAINED IN THE HANOVER SMOKESTACK EXPERIMENTS.

NOTE 1. The abscissas give the distance of the top of the blast nozzle below the smallest diameter of the stack; the ordinates denote the corresponding vacuum in inches of water.
2. The curves are plotted from an average of the values obtained, and they vary from the maxima and minima observed by from .02 inch to .08 inch.
3. All of the observations were made with the same steam pressure (3.94 inches of mercury) and with the same opening for the admission of air
4. The figures at the right hand end of each curve are the diameters of the corresponding blast nozzle or stack.

GENERAL DIMENSIONS OF THE VARIOUS CLASSES OF LOCOMOTIVES ON THE GRAND TRUNK RAILWAY.

Class of engine	No. 39 double ender with side and back tanks 17 in. × 22 in. × 5 ft. 2 in.	No. 82 express, 18 in. × 24 in. × 6 ft. 1⅝ in.	No. 93 express, 18 in. × 26 in. × 6 ft. 6 in.	No. 196 light passenger, 17 in. × 22 in. × 5 ft. 2 in.	No. 326 compound mogul "C. I." system, 19 in. and 29 in. × 26 in. × 5 ft. 2 in.	No. 572 simple mogul 18 in. × 26 in. × 5 ft. 2 in.
Gage	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.
Kind of fuel used	Bituminous.	Bituminous.	Bituminous.	Bituminous.	Bituminous.	Bituminous.
Weight on front truck, in working order	35,112 lbs.	38,528 lbs.	33,908 lbs.	32,704 lbs.	21,840 lbs.	16,184 lbs.
" " back " " "	19,712 "	......	......	......	......	......
Total weight on driving wheels " "	66,584 "	67,424 lbs.	52,360 lbs.	53,592 lbs.	96 572 lbs.	84,028 lbs.
" " of engine " "	121,408 "	105,952 "	86,268 "	86,296 "	118,412 "	100,212 "
" " " and tender " "	No tender.	190,848 "	160,868 "	160,896 "	199,398 "	180,412 "
From center of front truck to center of main driving wheels	10 ft. 8 in.	12 ft. 2 in.	12 ft. 2 in.	10 ft. 8 in.	15 ft. 2 in.	14 ft. 8½ in.
" " " " " " cylinders	10 " 8 "	12 " 2 "	12 " 2 "	10 " 8 "	11 " 7 "	11 " 4¾ "
" " to center of front truck wheels	6 " 6 "	6 " 6 "	6 " 6 "	6 " 6 "	......	......
" " of front truck to center of front driving wheels	......	......	......	......	8 ft	7 ft. 6¼ in.
" " " " driving wheels " " main "	......	......	......	......	7 ft. 2 in	7 " 2 "
" " " main " " " " " back "	8 ft	8 ft. 6 in.	8 ft. 6 in.	8 ft.	8 " 6 "	8 " 6 "
" " " back " " " " " " truck	7 " 4 in.	......	......	......	......	......
Rigid wheel base	8 "	8 ft. 6 in.	8 ft. 6 in.	8 ft.	15 ft. 8 in.	15 ft. 8 in.
Total wheel base of engine	29 " 5 "	23 " 11 "	23 " 11 "	21 ft. 11 in.	23 " 8 "	23 " 2¾ "
" " " " and tender	No tender.	47 " ¼ "	46 " 11 "	45 " 2⅝ "	46 " 7¼ "	46 " 7¼ "
" length of engine and tender over all	39 ft. 7¼ in. en. only	57 " 11⅛ "	57 " 11⅛ "	56 " 2¼ "	56 " 7¼ "	56 " 7¼ "
Length of main connecting rod, center to center	6 ft. 10 in.	8 "	7 " 10 "	6 " 10 "	7 " 3 "	7 " 3 "
CYLINDERS, VALVES, ETC.						
Transverse distance from center to center of cylinders	6 ft. 4 in.	6 ft. 4 in.	6 ft. 3½ in.	6 ft. 4 in.	6 ft. 9 in.	6 ft. 9 in.
Diameter of high pressure cylinder	17 in.	18 in.	18 in.	17 in.	19 in.	18 in.
" " low " "	......	......	......	......	29 "	......
Stroke of piston	22 in.	24 in.	26 in.	22 in.	26 "	26 in.
Kind " "	"C. I." box.	"C. I." box.	"C. I." box	"C. I." box.	"C. I." box.	"C. I." box.
Horizontal thickness of H. P. piston head in the center	4¾ in.	4¾ in.	4¾ in.	4¾ in.	4¾ in.	4¾ in.
" " " L. P. " " " "	......	......	......	......	5¾ "	......
Kind of piston packing	"C. I." rings sprung in.	"C. I." rings sprung in.	"C. I." rings sprung in.	"C. I." rings sprung in.	"C. I." rings sprung in.	"C. I." rings sprung in.
Diameter of H. P. piston rod	2⅞ in.	3⅛ in.	3⅛ in.	2⅞ in.	3⅛ in.	3⅛ in.
" " L. P. " "	......	......	......	......	3⅛ "	......
Size of H. P. steam ports	16 in. × 1¼ in.	18 in. × 1¼ in.	16 in. × 1¼ in.	16 in. × 1¼ in.	18 in. × 1⅛ in.	16 in. × 1¼ in.
" " L. P. " "	......	......	......	......	22½ " × 1⅛ "	......
" " H. P. exhaust "	16 in. × 3 in.	18 in. × 3¼ in.	16 in. × 3 in.	16 in. × 3 in.	18 " × 3 "	16 in × 3½ in
" " L. P. " "	......	......	......	......	22½ " × 3 "	......
Greatest travel of slide valves	5 7/16 in.	5⅝ in.	5¾ in.	5 7/16 in.	6¼ in.	5½ in.
Throw of eccentrics	5⅛ "	5¼ "	5½ "	5⅛ "	5 "	5 "
Inside lap of H. P. slide valve (or inside clearance)	1/16 "	Line and line.	Line and line.	1/16 "	Inside clear., ⅜ in.	Line and line.
" " " L. P. " " " "	......	......	......	......	" " ¼ "	......
Outside " " H. P. " "	11/16 in.	⅞ in.	⅞ in.	11/16 in.	1 in.	⅞ in.
" " " L. P. " "	......	......	......	......	⅞ "	......
Lead of H. P. slide valve in full gear	3/16 in.	1/16 in.	⅛ in.	3/16 in.	1/16 "	⅛ in.
" " L. P. " " " "	......	......	......	......	1/16 "	......
Throw of upper end of reverse lever from full gear forward to full gear backward, measured on the chord of the arc of its throw	4 ft. 1¾ in.	4 ft. 1⅜ in.	4 ft. ⅛ in.	4 ft. 5⅞ in.	3 ft. 11½ in.	3 ft. 11½ in.
Sectional area of opening of H. P. steam pipe	15.9 sq. in.	17 72 sq. in.	16.80 sq. in.	15.9 sq. in	23 76 sq. in.	17.72 sq. in.
" " " " dry pipe	28 29 " "	28 29 " "	28.29 " "	28.29 " "	28.29 " "	28.28 " "
Cubic capacity of receiver	......	......	......	......	4 25 " ft.	......
WHEELS AND AXLES.						
Diameter of driving wheels, outside of tire	5 ft. 2 in.	6 ft. 1⅝ in.	6 ft. 6 in.	5 ft. 2 in.	5 ft. 2 in	5 ft. 2 in.
Material of centers and style of tire fastenings	"C. I. Mansell" clip.	"C. I. Mansell" clip.	"W. I." forged spoke, Beattie clip and tire bolts	"C. I." tire bolts.	"C. I. Mansell" clip.	"C. I. Mansell" clip.
Diameter of front truck wheels, outside of tire	33 in.	37 in.	37 in.	33 in.	37 in.	37 in.
Material of centers and style of tire fastenings	"C. I. Mansell" clip.	"C. I. Mansell" clip.	"W. I." forged spoke, Beattie clip and tire bolts.	"C. I. Mansell" clip.	"C. I. Mansell" clip.	"C. I. Mansell" clip.
Diameter of back truck wheels, outside of tire	33 in.	......	......	......	......	......
Material of centers and style of tire fastenings	"C. I. Mansell" clip.	......	......	......	......	......
Size of front driving axle journals, diameter × length	......	......	......	......	7 in. × 8 in.	7 in. × 8 in.
" " main " " " " "	7 in. × 8 in.	8 in × 9 in.	8 in. × 9 in.	7 in. × 8 in.	7 " × 8 "	7 " × 8 "
" " back " " " " "	7 " × 8 "	8 " × 9 "	8 " × 9 "	7 " × 8 "	7 " × 8 "	7 " × 8 "
" " front truck " " " "	4½ " × 7½ "	5¼ " × 10 "	5 " × 7¾ "	4½ " × 7½ "	5½ " × 10 "	5 " × 7¾ "
" " back " " " " "	5½ " × 10 "	......	......	......	......	......
" " main crank pin " " "	4 " × 5 "	5¼ in. × 5⅛ in.	4½ in. × 5 in.	4 in. × 5 in.	4½ in. × 5 in.	4½ in. × 5 in.
" " wrist pin " " "	3½ " × 3¾ "	3¾ " × 3¾ "	3½ " × 3 "	3¾ " × 3¾ "	3¾ " × 3 "	3¾ " × 3 "
" " front coupling rod " " "	......	......	......	......	5 " × 3¼ "	5 " × 3½ "
" " Main " " " "	3¼ in × 4 in.	3⅝ in. × 3⅝ in.	3¾ in. × 3⅜ in.	3¼ in. × 4 in.	5½ " × 1⅜ "	5½ " × 1⅜ "
" " back " " " "	3¾ " × 4 "	3¾ " × 3¾ "	3⅝ " × 3¾ "	3½ " × 4 "	5 " × 3⅛ "	5 " × 3⅛ "
Length of front truck springs, center to center of hangers	2 ft. 11½ in.	2 " × 11¼ "	2 " × 11¼ "	2 ft. 11½ in.	2 ft. 6 in.	2 ft 6 in.
Number of plates	10.	13.	13.	11.	8	7.
Section of steel	3½ in. × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.	3½ in × ½ in.	3½ in × ½ in.	3½ in. × ½ in.
Length of driving springs, center to center of hangers	3 ft. 3½ in.	3 ft. 3½ in.	3 ft. × 3½ "	3 ft. 3½ in.	2 ft. 10 in.	2 ft. 10 in.
Number of plates	12.	12.	12	10.	10.	9.
Section of steel	4 in × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.	4 in. × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.
Length of back truck springs, center to center of hangers	2 ft. 6 in.	......	......	......	......	......
Number of plates	8.	......	......	......	......	......
Section of steel	3½ in. × ½ in.	......	......	......	......	......
BOILER.						
Description of boiler	Straight back.	Straight back.	Straight back.	Straight back	Straight back.	Straight back.
Inside diameter of smallest ring of boiler	4 ft. 0¾ in.	4 ft. 2¾ in.	4 ft. 2¾ in.	4 ft. 0¾ in.	4 ft. 2¾ in	4 ft. 2¾ in
Material of barrel of boiler	Steel.	Steel.	"Bowling" iron.	"Bowling" iron.	Steel.	Steel.
Length of barrel from back of front tube plate to front of throat	10 ft. 1 in.	11 ft. 10¾ in.	11 ft. 10¾ in.	10 ft. 1 in.	11 ft. 2¼ in.	11 ft. 2¼ in.
Thickness of plates in barrel of boiler	⅝ in.	½ in.	½ in.	9/16 in.	½ in.	½ in.
Kind of horizontal seams	Butt, inside and outside welts, double riveted.	Butt, inside and outside welts, double riveted.	Butt, inside and outside welts, double riveted.	Lap, double riveted.	Butt, inside and outside welts, double riveted.	Butt, inside and outside welts, double riveted.
" " circumferential seams	Lap, double Riveted.	Lap, double riveted.	Butt, with welt outside and single riveted.	Lap, double riveted.	Lap, double riveted.	Lap, double riveted.
Material of tubes	Charcoal iron.	Charcoal iron.	Charcoal iron.	Charcoal iron.	Charcoal iron.	Charcoal iron.
Number " "	173.	190.	212.	196	190.	190.
Diameter " outside	1¾ in.	1¾ in.	1¾ in.	1¾ in.	1¾ in.	1¾ in.
Distance between centers of tubes	2 7/16 "	2 7/16 "	2⅜ "	2⅜ "	2 7/16 "	2 7/16 "
Length of tubes over tube plates	10 ft. 8 5/16 in.	12 ft. 5 9/16 in.	12 ft. 3 5/16 in.	10 ft. 8 5/16 in.	11 ft. 9 1/16 in.	11 ft. 9 1/16 in.
" " firebox outside	6 " 2 "	8 " 9 "	8 " 9 "	6 " 2 "	6 " 9 "	6 " 9 "
Width " "	Mean, 3 ft. 10½ in.	3 " 6⅛ "	3 " 6⅛ "	Mean, 3 ft. 10½ in	3 " 6⅝ "	3 " 6⅝ "
Length " " inside at foundation ring	5 ft. 6 5/16 in.	6 " 2 1/16 "	6 " 1 1/16 "	5 ft. 6 5/16 in.	6 " 2 1/16 "	6 " 2 1/16 "
Width " "	Mean, 5 ft. 2⅞ in.	2 " 11⅝ "	2 " 11 "	Mean, 3 ft. 2⅞ in.	2 " 11⅝ "	2 " 11⅝ "
Depth " " from bottom of foundation ring	" 5 " 0⅞ "	5 " 9¼ "	6 " 2½ "	5 ft. 4¼ in	5 " 9¼ "	5 " 9¼ "
Water space, sides of firebox at foundation ring	3 in.	2½ in	3 in.	3 in.	2½ in.	2½ in.
" " back " " " "	3 "	2½ "	3 "	3 "	2½ "	2½ "
" " front " " " "	3 "	2½ "	3 "	3 "	2½ "	2½ "
Material of outside shell of firebox	Steel.	Steel.	"Bowling" iron.	"Bowling" iron.	Steel	Steel.
Thickness of plates of outside shell of firebox—throat, face, sides, saddle	7/16 in., ½ in., ⅜ in., ½ in.	7/16 in., ½ in., 7/16 in., 7/16 in.	7/16 in., ½ in., 7/16 in., 7/16 in.	7/16 in., ⅜ in., ⅜ in., ⅜ in.	7/16 in., ½ in., 7/16 in., 7/16 in.	7/16 in., ½ in., 7/16 in., 7/16 in.
Material of inside of firebox	Steel.	Steel.	Steel.	Steel.	Steel.	Steel.
Thickness of side sheets of firebox	5/16 in.	5/16 in.	5/16 in	5/16 in.	5/16 in.	5/16 in.
" " back sheet "	5/16 "	5/16 "	5/16 "	5/16 "	5/16 "	5/16 "
" " " tube sheet	½ "	½ "	½ "	½ "	½ "	½ "
" " crown sheet	⅜ "	⅜ "	⅜ "	⅜ "	⅜ "	⅜ "
Material of front tube sheet	Steel.	Steel.	"Bowling" iron.	"Bowling" iron.	Steel.	Steel.
Thickness " " "	⅝ in.	¾ in.	¾ in.	⅝ in.	¾ in.	¾ in.
How crown sheet is stayed	Radial, 1⅛ in. diameter.	Radial, 1⅛ in. diameter, two front rows fitted for expansion.	Radial, 1⅛ in. diameter, two front rows fitted for expansion.	Radial, 1⅛ in. diameter.	Radial, 1⅛ in. diameter, two front rows fitted for expansion.	Radial, 1⅛ in. diameter, two front rows fitted for expansion.
Diameter of dome inside	2 ft. 1 in.	2 ft. 5⅛ in.	2 ft. 1 in.	2 ft. 1 in.	2 ft. 5⅛ in.	2 ft. 5⅛ in.
Height " " to joint face	2 " 9 "	2 " 11⅛ "	2 " 9 "	2 " 9 "	2 " 11⅛ "	2 " 11⅛ "
Extension smokebox, outside diameter by length from joint face of front to face of tube sheet	4 ft. 5⅛ in. × 5 ft. 5¾ in.	5 ft. 0 in. × 5 ft. 8½ in.	6 ft. 0 in. × 5 ft. 7¾ in.	4 ft. 5⅛ in. × 5 ft. 8⅞ in.	5 ft. 0 in. × 4 ft. 5⅛ in.	5 ft. 0 in. × 5 ft. 8¼ in.
Maximum working pressure per square inch	140.	160.	160	140.	180.	160.
Kind of grate	"C. I." rocking.	"C. I." rocking.	"C. I." rocking	"C. I." rocking	"C. I." rocking	"C. I." rocking.
Width of grate bars	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root.
" " air space between grate bars	⅝ in. [illegible]	⅝ in.	⅝ in.	⅝ in. [illegible]	⅝ in.	⅝ in.
Grate area	17.85 sq. ft.	18.25 sq. ft.	17.75 sq. ft	17.85 sq. ft.	18 25 sq. ft.	18.25 sq. ft.
Heating surface, firebox	96 50 "	106.50 "	119.50 "	102.20 "	106.50 "	106.50 "
" " outside of tubes	818 00 "	1,077.35 "	1,184 07 "	950.00 "	1,015 61 "	1 015 61 "
Total heating surface	914 50 "	1,183.85 "	1,303.57 "	1,052.20 "	1,122.11 "	1,122.11 "
Effective cross sectional area through tubes	2.21 "	2.14 "	2 71 "	2.50 "	2 11 "	2.11 "
Kind of blast nozzle	Single	Single.	Single.	Single.	Single.	Single.
Diameter of blast nozzle	4 in.	4¼ in.	4¼ in.	4 in.	4 1/16 in.	4¼ in.
Smallest inside diameter of stack	1 ft. 3⅝ in.	1 ft. 5⅝ in.	1 ft. 5⅝ in.	1 ft. 4⅝ in.	1 ft. 1 in.	1 ft. 5⅝ in.
Height from top of rail to top of stack	13 " 0 "	14 " 5 "	14 " 9 "	14 " 1 "	14 " 1⅜ "	14 " 1⅜ "
" " " " " " center of boiler	6 " 3½ "	6 " 10⅝ "	7 " 0 "	6 " 3½ "	7 " 0 "	6 " 7¾ "
Style of frames	Bar in front and slab at back	Bar throughout.	Bar throughout.	Bar in front and slab at back	Bar throughout.	Bar throughout.
" " driver brakes	American equalized on drivers and trailers	American equalized clasp on drivers and trailers.	None.	None	None	None.
System of sanding	"Gresham's" patent steam sanding for U. & T.	"Gresham's" patent steam sanding.	"Gresham's" patent.	Ordinary, by hand.	Ordinary, by hand.	Ordinary, by hand.
Style and size of injectors	G. T. R. Nos 7 and 8.	Holden & Brook's Combination, 1892. Nos 8 and 9.	G. T. R. Nos 8 and 9	G. T. R. Nos. 7 and 8.	Holden & Brook's Combination, 1892. Nos. 8 and 9.	G. T. R. Nos. 8 and 9
Engines are fitted with baffle plates, firebrick arches and water tubes for carrying same						
Service for which engine is intended	Suburban.	Express.	Express.	Light passenger.	Freight.	Freight.
Water capacity of side and back tanks in gallons of 231 cubic inches	1,600 gals.	......	......	......	......	......
Capacity of coal space, cubic feet	93 cu. ft.	......	......	......	......	......

(*d*) Five conical stacks with an inclination of ⅙ and the same minimum diameter, as shown in Fig. 17.

(*e*) Three funnel-shaped stacks (without a waist), of which one had an inclination of ⅙ and a minimum diameter of 13.78 inches, and two having inclinations of $\frac{1}{12}$ and minimum diameters of 13.78 inches and 15.75 inches, as shown in Fig. 18.

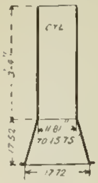


Fig. 15.

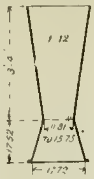


Fig. 16.

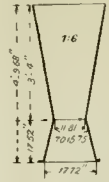


Fig. 17.

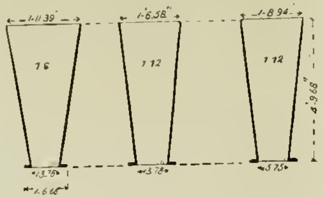


Fig. 18.

In the steam pipe leading from the boiler to the apparatus, which had a diameter of 2.76 inches, a cut-off valve, a throttle valve and a metallic manometer were placed. The throttle valve was fastened in a convenient position near to the apparatus where a wooden booth was set up, in which the measuring instruments were placed and from which the apparatus itself could be readily watched through a window. A reading o the instruments in the open, while the apparatus was in blast, would not have been possible, since the outrushing steam made an ear-bursting racket, and the stack emitted the hot condensation of the steam, while showers of water prevailed all about.

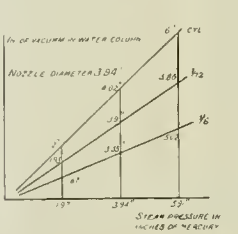


Fig. 19.

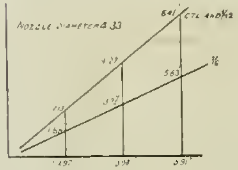


Fig. 20.

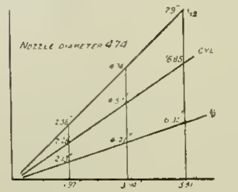


Fig. 21.

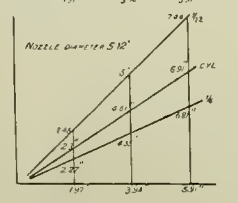


Fig. 22.

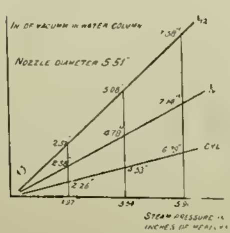
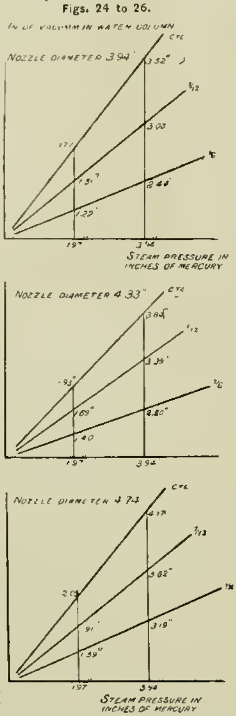


Fig. 23.

Before an experiment began the apparatus, whose steam chamber was well protected by a thick layer of felt against cooling, was thoroughly warmed. The water of condensation of this chamber was carried off by a pipe that was left in the open. The steam pressure was held within the limits of from 67 pounds to 75 pounds per square inch. In order that this great outpouring of steam might be maintained it was found necessary to force all three boilers of a neighboring battery up to their full power, though ordinarily they served to supply steam to a small steam engine and several steam hammers. With only two boilers in service, though the fires might be burning briskly, the steam pressure would gradually drop as much as four inches in the mercury column, which rendered accuracy in the results impossible; though this same variation was not observable in the metallic gage. This is offered in explanation of the contradictory results obtained by the Prüssmann experiments. While with him the pressure of the very small amount of steam emitted was measured by a sensitive instrument, the small variations of boiler pressure were allowed to pass unheeded, though they had the greatest influence upon the amount of steam emitted; in the Hanover experiments the great outflow of steam was controlled by a delicate instrument. In consequence of the latter condition and the making of a great number of observations, for in all more than thirty thousand readings were taken, the values obtained showed a very uniform open during the experiment. By means of the throttle valve the pressure in the steam chamber was kept at the same height while the blast was in operation. The metallic gage served to indicate the pressure existing in the boilers which course when plotted in the form of a diagram. The variation of the maximum and minimum values from the basis established by the general average was, in the majority of cases, about .04 inch at the most, and seldom ran as high as from .08 inch to .12 inch. The observations repeated in different months gave the the same ratios with the same stacks, and always the same vacuum was reproduced. The temperature of the air only had an influence upon the results in so far as that the readings taken during the colder months for each position of the blast pipe fell from .12 inch to .2 inch lower than when the weather was warm, due to the fact that the current of steam clung more closely to the sides of the stack. This affects, then, only the boundary limits of the dropping ends of the curves, and consequently the position of the nozzle, which is not changed in practice, and is, therefore, of no importance in connection with the respective stacks.



Figs. 24 to 26.

We next took up the task of establishing the relationship existing between the pressure in the blast-pipe and the vacuum. Already in his experiments with a locomotive under steam but stationary, Clark had obtained results sufficient to prove the proposition that the vacuum stands in a direct ratio to the blast-pipe pressure. This was investigated with the apparatus with stacks having the greatest variations of diameter and length and with all five of the blast nozzles, and was found to be in exact correspondence in every instance.

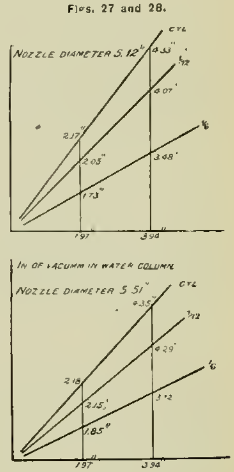
If we take the blast-pipe pressure as abscissas and the corresponding vacuums as ordinates, the end points of the latter will form straight lines. In Figs 19 to 23 these diagrams are given for the operation of a stack having a diameter of 13.78 inches. The blast-pipe position for all 15 of the readings was the same, or 1 foot 10 inches. Equal abscissas correspond to equal steam pressures. If the latter were twice, four times, or five times as great, the vacuum would increase twofold, fourfold, or fivefold, as the case might be.

The amount of steam issuing forth increases as the diameter of the nozzle is made larger, about in the ratio of the square of the diameter of the nozzle. If we consider that the amount of steam issuing from a nozzle 4 inches in diameter to be equal to 1, it follows that, with the same steam pressure and a

Nozzle diameter = 4 inches, the steam delivered = 1 00
" " = 4.4 " " " " = 1 21
" " = 4.8 " " " " = 1.44
" " = 5 2 " " " " = 1 69
" " = 5.6 " " " " = 1 96

Notwithstanding the fact that with a nozzle diameter of 5.6 inches, nearly twice as much steam is delivered as would be through one only 4 inches in diameter, a casual comparison of these five diagrams shows that the vacuum rises in a far smaller ratio.

To make this still clearer, the following figures are brought together.



Figs. 27 and 28.

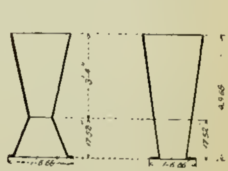


Fig. 29.

TABLE I.

Diameter of stack.	Shape of stack.	Increase in the vacuum with the nozzle located at 22 in., if the nozzle diameter is opened from 4 in. to 5.6 in.
13.78 in....	Cylindrical..	From 4.08 to 4.6 in. = .52 in. = 12.7 per ct.
	Conical $\frac{1}{12}$ ..	" 3.96 " 5.14 " = 1.18 " = 30.7 "
	Conical ⅙ ...	" 3.4 " 4.84 " = 1.44 " = 42.3 "
15.75 "	Cylindrical..	" 3.58 " 4.42 " = .84 " = 23.4 "
	Conical $\frac{1}{12}$ ..	" 3.08 " 4.36 " = 1.28 " = 41.5 "
	Conical ⅙....	" 4 88 " 3.78 " = 1.1 " = 52.4 "

Hence, if the outflow of steam increases by about 100 per cent., the vacuum (under this ratio) will increase about 52 per cent., the shape of the stack remaining the same.

From these five diagrammatic representations we can readily see, without any further demonstration, how a cylindrical stack having a diameter of 13.78 inches falls off in its action with the same amount of steam as compared with the conical stack. With a nozzle diameter of 4 inches the cylindrical form seems to be the best when taken in connection with the height of the vacuum; at a diameter of 4.4 inches it nearly coincides with the conical form having an inclination of one-twelfth; with a further opening of the blast nozzle it drops down below the last-named form, until at a diameter of 5.2 inches for the nozzle it has fallen even below the stack having an inclination of one-sixth.

In other respects the diagrams show that the action of the cylindrical stacks is very much better than that of the conical if we take stacks having a larger diameter than 13.78 inches. It so happens, then, that under the same ratios as shown in Figs. 19 to 23, that with stacks having a diameter of 14.76 inches, the cylindrical stack first coincides with the conical stack having an inclination of one-twelfth when the nozzle has a diameter of 5.08 inches. With a diameter of 15.75 inches, as well as with all five diameters of nozzle, the cylindrical form is superior to the conical (the nozzle position being 1 foot 10 inches) as is shown by Figs. 24 to 28.

We next have to show the reason why we believe, from the results obtained from the experimental apparatus, that a cylindrical stack 13.78 inches in diameter and 4 feet 9.08 inches high, is too small to be used with a nozzle 4.33 inches in diameter, just as a stack of 14.76 inches in diameter is too small for a nozzle having a diameter of 5.08 inches or more. And we are inevitably led to the further conclusion that the cylindrical stack, as being also superior at the smallest cross-section, must be preferred to the conical stack if we expect to maintain the same vacuum with the two forms under the same conditions. Likewise the conical stack should be given different inclinations, and the narrow inclination of $\frac{1}{12}$ be increased to $\frac{1}{6}$, as shown later in Section X.

Finally, we can state, as a well-defined conclusion, that the blast pipe pressure has no influence upon the form of the stack, a conclusion that Prüssmann has already announced as the result of his experiments. Figs. 19 to 23 and 24 to 28 show this to be the case without the necessity of any further references; for the trend of the vacuum lines for the three different shapes of stacks maintains the same relationship to each other for all blast-pipe pressures, the nozzle diameters remaining the same. This position permits one to choose any steam pressure that may be desired for the experiments, even though it may not exactly correspond with the blast pipe pressures as they exist in the locomotives. The Hanover experiments were now conducted with a steam pressure of 3.94 inches of the mercury column, a value which, as was afterward established, corresponded almost exactly with that existing on the standard passenger locomotives when running at a speed of from 34 to 37 miles per hour, a cut-off at .2 stroke, and exhausting through a nozzle of 4.74 inches in diameter. All of the experiments with the 18 stacks, of which 15 were in four different lengths, were made with this steam pressure, the openings into the air chamber remaining the same, and all other conditions being unchanged.

Each stack was tested with five different diameters of nozzle openings. In all there were 320 different combinations of stack and nozzle relations tested. In each of these relations there were at least 10 different positions of the nozzle employed and as many curve points marked with six readings each for the purpose of reaching a definite conclusion.

(*To be Continued.*)

The Holding Power of Lag Screws.

A correspondent in the *American Machinist* gives the following information concerning some experiments he made on the holding power of lag screws:

The holes were bored by a common carpenter's bit in 8-inch square logs, and the screws put in same as would be in common practice, and they were pulled out by the use of an Olsen testing machine.

Diameter of screw.	Diameter of bit.	Length of thread screwed into the wood.	Kind of wood.	The load at which screw pulled out.
7/8 inch.	5/8 inch.	3 inches.	Spruce	5,900 lbs.
7/8 "	11/16 "	3 "	"	5,900 "
7/8 "	3/4 "	3 "	"	6,100 "
7/8 "	3/4 "	5 "	"	9,000 "
7/8 "	3/4 "	5 "	Chestnut	9,500 "
3/4 "	5/8 "	4½ "	Spruce	7,000 "
3/4 "	5/8 "	4½ "	Pitchpine.	8,300 "
5/8 "	1/2 "	4 "	Spruce	6,000 "
5/8 "	3/8 "	3½ "	"	3,500 "
5/8 "	7/16 "	2 "	"	1,900 "
1/4 "	3/16 "	1 "	"	700 "

This experiment seems to indicate that there is no advantage in using too small a bit when boring holes for lag screws. For instance, the $\frac{7}{8}$ screw required full as much force to pull out from a $\frac{3}{4}$ hole as it would take to pull out of a $\frac{5}{8}$ hole, although it is a great deal easier to put the screw in after a $\frac{3}{4}$ bit than it is after a $\frac{5}{8}$ bit, and it is certainly work spent in the wrong direction to use a bit smaller than the core of the screw.

By splitting the block and examining the wood around the screws, it will be found that when too small bits are used, the fibers in the wood around the screws are crushed and destroyed, but when the right size of bit is used the thread in the wood around the screw looks clean cut, the texture of the fibers is pressed and the fit in the wood on the screw resembles the appearance of a nut on a bolt.

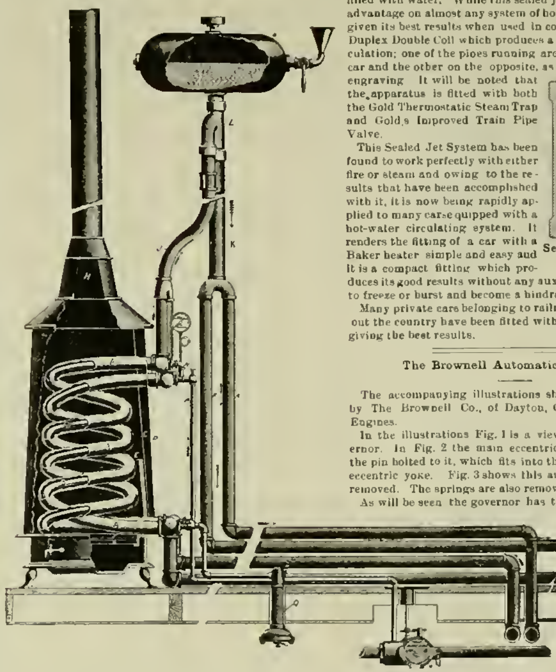
When the $\frac{7}{8}$ screw was screwed into a $\frac{3}{4}$ hole its full length of thread, or five inches, it required a force of 9,000 pounds to pull it out; therefore it is safe enough for any temporary job under a steady stress to lift one ton in a $\frac{7}{8}$ lag screw, as this gives about four as factor of safety in pulling out of the wood, and there is no danger of pulling off the screw itself, because at the place of the core where it could break it is about $\frac{11}{16}$ inch, in diameter = 0.37 square inch area.

Assuming ultimate tensile strength to be 50,000 pounds per square inch, the breaking load would be 50,000 × 0.37 = 18,500 pounds; thus there is no danger at all of the screw itself breaking for a load of a ton.

Gold's Improved Sealed Jet System of Hot Water Circulation.

A great improvement and advancement in a hot water circulating system for cars equipped with the Baker heater has been recently developed by Mr. Edward E. Gold, President of the Gold Car Heating Company.

The desirable and requisite feature of this style of equip-



Gold's Sealed Jet System of Hot Water Circulation.

ment has been to obtain a rapid circulation of the water through the pipes of the car.

The effects of the rapid circulation being the more effusive radiation of heat from the outgoing pipes of the coil, and in consequence the more thoroughly heated return.

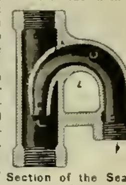
When steam is let into the coil equipped with the Gold sealed jet, a complete circulation of the water takes place in from eight to eleven minutes, and in a correspondingly short length of time when fire is used.

Heretofore, on some few railways, it has been the practice to jet the steam into the water for the purpose of securing a more rapid circulation, but great objection has been made to this from the fact that it has been impossible to use salt water or other non-freezing liquids in the pipes when such steam or commingler jet is used. The result is that the use of fresh water is made necessary, and immediately the steam is shut off the jet or the fire extinguished the pipes are very liable to freeze and burst, and, in some cases, where the brakemen or porters have started a fire in the stove where the pipes were frozen the result has been some very terrific explosions, often blowing the car to pieces.

The Gold Sealed Jet, which can be used with any kind of water, whether fresh or salt, or the regular Gold patented non-freezing solution, the same as now being used in the Broadway cars, is a double extra heavy fitting, having somewhat the outward appearance of a back outlet return bend, but as can be seen from its sectional view in the accompanying illustration, one port of the bend is carried into the vertical section *D*, and this port so carried into the vertical section is slightly tapered like the nozzle of a water hose. At the upper end of this nozzle there is a small hole *A*, tapped to one-eighth inch.

In this condition the jet is connected with the expansion drum making only one connection into the drum. When steam is turned on the coil and the water begins to heat and rise through the pipe *J*, it enters the jet at the opening *C*, passes around through the bend and owing to the taper of the nozzle is forced down the pipe with considerable energy. Any air which might be mingled with the water will rise to the drum as the water leaves the opening *B*.

The purpose of the ⅛ inch tapping made into the nozzle at the upper side is to omit any particles of air that might settle in the jet proper when the pipes of the car are being filled with water. While this sealed jet can be used to great advantage on almost any system of hot water heating it has given its best results when used in connection with Gold's Duplex Double Coil which produces a double or divided circulation; one of the pipes running around one side of the car and the other on the opposite, as is also shown in the engraving. It will be noted that the apparatus is fitted with both the Gold Thermostatic Steam Trap and Gold's Improved Train Pipe Valve.



Section of the Sealed Jet.

This Sealed Jet System has been found to work perfectly with either fire or steam and owing to the results that have been accomplished with it, it is now being rapidly applied to many cars equipped with a hot-water circulating system. It renders the fitting of a car with a Baker heater simple and easy and it is a compact fitting which produces its good results without any auxiliary drums or jackets to freeze or burst and become a hindrance to the car.

Many private cars belonging to railroad officials throughout the country have been fitted with this system which is giving the best results.

The Brownell Automatic Governor.

The accompanying illustrations show the governor used by The Brownell Co., of Dayton, O., on their Automatic Engines.

In the illustrations Fig. 1 is a view of the complete governor. In Fig. 2 the main eccentric is removed, showing the pin bolted to it, which fits into the hole in the auxiliary eccentric yoke. Fig. 3 shows this auxiliary eccentric yoke removed. The springs are also removed in this view.

As will be seen the governor has the usual arrangement of weights and springs, and belongs to that class of governors in which the eccentric swings from a fixed point. The principal feature of the governor is the manner in which the motion of the weights is transmitted to the main eccentric. As is shown in Fig. 3, the weights are connected by links to the ears of the auxiliary eccentric which is fitted to turn upon the hub of the governor wheel, so that as the weights are moved the auxiliary eccentric is turned around the shaft. This auxiliary eccentric is fitted with a yoke, or strap, which is shown in position in Fig. 2 and removed in Fig. 3. In this yoke is a hole which receives the pin bolted to the main eccentric in Fig. 2. Thus, as the auxiliary eccentric is turned around the shaft, its yoke is thrown across, carrying with it the main eccentric, which is thus moved nearer to or farther from the center, and thereby decreasing or increasing its throw.

The advantages of this combination of eccentrics are that the governor is mechanically locked in every position it assumes, and can only be moved by pulling on the weights, the pull of the valve having no effect whatever, while at the same time the governor is free and certain to act, sensitive, strong and durable.

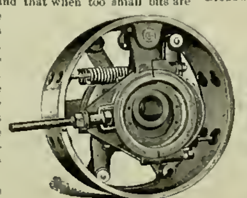


Fig. 1.

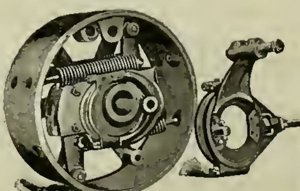


Fig. 2.

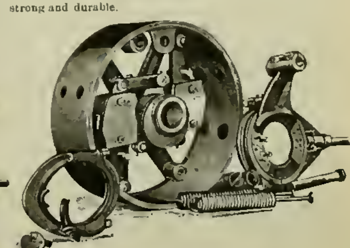


Fig. 3.

The Brownell Automatic Governor.

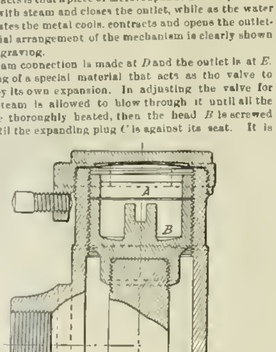
To reverse the governor, the pin bolted to the main eccentric is changed to the holes shown on the opposite side in Fig. 2, the weights and springs are changed to the holes provided for them, and the operation is complete. Engineers who have had to reverse some of the "Chinese Puzzles" on the market will appreciate the simplicity of this operation.

The governor is compact, yet all adjustable parts are very accessible. All wearing parts are circular in form, thus insuring smooth, uniform wear. The entire wear of the governor is taken up by two simple adjustments. lay. governor was designed and patented by H. C. C Supt. of the Engineering Dept. of The Brownell Co.

The Diamond Steam Trap.

The steam trap which we herewith illustrate, by means of a longitudinal section, is one that is being made by Jenkins Bros., of 71 John street, New York. The principal upon which it acts is that a piece of metal expands as it is placed in contact with steam and closes the outlet, while as the water accumulates the metal cools, contracts and opens the outlet. The special arrangement of the mechanism is clearly shown in the engraving.

The steam connection is made at *D* and the outlet is at *E*. *C* is a plug of a special material that acts as the valve to close *D* by its own expansion. In adjusting the valve for service, steam is allowed to blow through it until all the parts are thoroughly heated, then the head *B* is screwed down until the expanding plug *C* is against its seat. It is



held in place by the check *A* and the whole covered and protected by a cap that is screwed down and held in position by a set screw. Then as the water accumulates in *D* and the interior of the valve cools the plug *C* contracts and allows the water of condensation to pass through and out, but by the time it has escaped the heat of the latter portion of the water or the steam that is following reheats the plug, causing it to again expand and close the opening at *D*.

Such a trap as this will take care of the water condensing in a line of 1-inch pipe 1,000 feet in length.

The wide range covered by the articles manufactured by the Trenton Iron Company is, perhaps, not generally known. One of their wide-spreading branches of specialties is the making of wire and wire ropes of all kinds, cable hoists, mine haulage and other equipments for the transportation of materials by means of wire rope. Then comes the other specialties of music wire, dress stays, corset, clock springs and umbrella wire, the quality of which is superior to that of imported brands, for quality rather than quantity is the object aimed at, and one evidence of this superior quality is to be found in the numerous awards granted them at the Columbian exposition in Chicago, where they had a large and interesting display, one feature being a coil of wire in one piece 33 miles long and weighing but 11 pounds. They have recently produced a special grade of resistance wire for electrical heaters that is meeting with great favor. Other lines are the locked wire rope, Bleicher's wire rope tramways and a bale tie known as the "Anchor" tie. To assist in the dissemination of information regarding the use of wire and wire rope they have published a little book entitled "Wire Rope Transportation in All its Branches," describing the different systems of wire rope tramways, cable hoists, surface and underground haulage plants, the equipments for which are manufactured by the company. It also contains descriptions of many of the lines built by them with illustrations taken from photographs. In addition to this it also contains considerable information of value to engineers. It is sent free on application.

The Q. & C. Co. have recently put a new wood preservative upon the market. The attention of the company was called to this in connection with its work in the development of the Servis tie plate. The new compound is known as the Q. & C. Carbolineum or wood preservative, but it is by no means an untried article, as it has been in use by several street and steam railroad companies for a number of years. The uses to which it can be applied are very numerous, and it will be found to be especially valuable to the car builder who can use it to great advantage either for car timbers or for the ends only, and for the floors of stock cars, while in other railroad work it will be useful in the construction of platforms, crossings, signal box, and in fact wherever either wet or dry rot is possible and finally it is claimed to be a sure preventive against the teredo.

CAMBRIA IRON COMPANY AND THE LATROBE STEEL COMPANY.—Mr. L. R. Pomeroy announces that he has been appointed sales agent for these two companies with an office at 33 Wall street, New York.

Messrs. Burnham Williams & Company announce tha Messrs Samuel M. Vauclain, Alba B. Johnson and George Burnham, Jr., were admitted into partnership in their firm on Jan. 1st.

Improved Freight Service South.

In keeping with the general policy adopted by the Southern Railway since its reorganization the management has instituted an entirely new freight service, which will, no doubt, be welcomed with delight by all Southern merchants and shippers. Taking effect on December 31, 1895, this road will operate both South and North bound in connection with the Old Dominion S. S. Company, from Pier 26, N. R., New York City via Norfolk (Pinner's Point), Va., instead of via West Point, Va., as heretofore; and, while this change in itself is a manifest advantage, the officials have gone even further by introducing a daily steamer service from and to this port, which will be the means of their being able to make from 12 to 24 hours less on all freights to any point in the South and Southwest, as former service was only a tri-weekly one.

The freight lines thus operated are the Piedmont Air and Paint Rock Lines, both popular for years past as fast freight lines South.

The unswerving energy constantly displayed by the Southern Railway toward giving to the public the very best possible freight service available, will, no doubt, be amply rewarded and recognized by all shippers, in increased patronage over its various lines, and in the race for speed and dispatch, the *Piedmont Air* and *Paint Rock Lines* can, with the daily steamers of the Old Dominion Steamship Company, show a clean pair of heels to all competing lines to any points they reach.

Big Verdict Against Pullman.

Judge Butler filed an opinion in United States Circuit Court to-day, dismissing the exceptions to and confirming the report of Theodore M. Etting, the Master in the Central Transportation Company-Pullman Palace Car Company case. Under the finding there is an award of $2,522,000 and eleven years' interest in favor of the Central Transportation Company.

The suit was brought by the Central Company to recover rentals, and it has been in litigation for a long while. Judge Butler said that the Master was appointed in pursuance of the opinion filed Dec. 18, 1894, to ascertain the value of the property transferred and the amount of its earnings. The Master found the value to be $2,522,000, and reports that no estimate of earnings can be made from the data furnished, and that the Pullman Company failed to produce—though requested to do so—evidence in its possession.

The *Pilgrim* (holiday number) is full of bright sketches—prose, poetry and illustrations—by bright writers and artists. Entirely original, new and entertaining. Mailed free to any address on receipt of six (6) cents in postage stamps. Write to Geo. H. Heafford, publisher, 415 Old Colony Building, Chicago, Ill.

An enigmatical bill of fare, for a dinner served on the dining cars of the Chicago, Milwaukee & St. Paul Railway, will be sent to any address on receipt of a two-cent postage stamp. Apply to Geo. H. Heafford, General Passenger Agent, Old Colony Building, Chicago, Ill.

The passenger department of the New York Central & Hudson River Railroad has issued a pamphlet advertising New York as a winter resort. It contains 64 pages of information about hotels, theaters, shops, restaurants, notable buildings, localities, etc., and directions for getting about. There is an original map of New York, made expressly for the book, and is printed in colors. A copy will be sent free, post paid, to any address in the world on receipt of two 2-cent stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

The Standard Boiler Company, of Chicago, report a good business during the past year. They have moved into their new offices, 1120 and 21 Marquette Building. These boilers are built by the well-known firm, Link-Belt Machine Company, of Chicago, who have put in new and improved machinery for their manufacture, reducing the prime cost as well as making the various parts interchangeable. During the past year a number of fine plants have been installed, among others being 4,000 horse power, for the North Chicago Street Railroad Company at their new power station at Hawthorn avenue. 500 horse power, for the Cincinnati Edison Company, at Cincinnati, O.; 600 horse power for the Western Electric Company, at their factory in Chicago, and various others. The report prospects for the coming year is good.

The Russell Wheel and Foundry Company are very busy in making logging cars, have orders ahead for two months. They make cars for special purposes, such as for soda ash work and for blast furnace works; also flat cars for street railway service.

A good natured German, who was the prosperous proprietor of a considerable clothing business in a country town had in his employ a clerk named John, whom he had advanced from cash boy to head clerk, and who had for many years been an attache of the store. Since his promotion John had several times asked for a raise in his salary, and each time his request had been granted. One morning John again appeared at the old merchant's desk with another request for an increase of $10 per month. "Vy, Sohn," said the employer, "I dink I bays you putty vell alretty; vat for I bays you any more?" "Well," replied John, confidently "I am your principal help here; I have worked you up a large trade; I know every detail of the business, and indeed I think you could not get along without me." "Is that so?" exclaimed the German, "Mein Gott! Shon, vot vood I do suppose you vas to die?" "Well," hesitated John, "I suppose you would have to get along without me then." The "old man" took several whiffs from his big pipe and said nothing. At last he gravely remarked: "Vell, Shon, I guess you petter gonsider yourself dead."

Our Directory

OF OFFICIAL CHANGES IN JANUARY.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atlanta & West Point.—Mr. Robert T. Pace has been appointed Purchasing Agent for this road and the Western Railway of Alabama.

Atlantic & Pacific.—Mr. Charles W. Smith has been appointed Receiver to succeed Messrs. Aldace F. Walker and John J. McCook, who resigned a few weeks ago.

Augusta Southern.—James N. Jackson is President and General Manager; P. H. Langdon, Vice-President, and W. F. Scofield, Superintendent, Secretary and Treasurer.

Boston & Maine.—General Manager T. A. Mackinnon has been appointed First Vice-President with authority over the operative and constructive departments. Division Superintendent Geo. F. Evans has been appointed Assistant General Manager, with headquarters at Boston, and Assistant Division Superintendent William G. Bean has been appointed Superintendent of the Southern Division with headquarters at Boston.

Baltimore & Lehigh.—Mr. G. W. Seidel has been appointed Master Mechanic, with headquarters at Baltimore, Md.

Chateaugay.—W. W. Conaughty has been appointed Superintendent.

Chicago & Great Western.—Purchasing Agent James Warwick has resigned.

Chicago, Rock Island & Pacific.—Foreman of Car Department George Hesnan has been appointed General Car Inspector, with headquarters at Grand Junction, Colo.

Chicago & Eastern Illinois.—Mr. Thomas A. Lawes has been appointed Superintendent of Motive Power to succeed Mr. Allen Cooke, resigned.

Cleveland, Cincinnati, Chicago & St. Louis.—George Tozser has been appointed Purchasing Agent.

East Broad Top.—Acting Superintendent A. W. Greenwood has been appointed Superintendent.

Erie.—General Foreman Willard Kells, of the Meadville, Pa., shops, has been appointed Master Mechanic of the Cleveland shops.

Master Mechanic George Donahue has been transferred from the Cleveland shops to Meadville, Pa.

Erie Lines West.—Col. A. M. Tucker will hereafter have the title of General Agent with headquarters at Cleveland.

Forest City & Sioux City.—John F. Way has been appointed Receiver.

Galveston, La Porte & Houston.—Messrs. T. W. House and M. T. Jones have been appointed Receivers.

Great Northern of England.—Mr. H. A. Ivatt has been appointed Locomotive Superintendent to succeed Mr. Patrick Sterling, deceased.

Hoosac Tunnel & Western.—Mr. W. O. McNeill has been appointed Master Mechanic, with headquarters at Readsboro, Vt.

Hutchinson & Southern.—Mr. L. E. Walker has been appointed Receiver.

Illinois Central.—Assistant Superintendent of Motive Power J. J. Casey has resigned.

Indiana, Decatur & Western.—The following appointments are announced: President, —— Woodford; Treasurer, F. H. Short; Auditor, G. W. Lishawa; Secretary and Purchasing Agent, George B. Balch.

Kansas City, Fort Scott & Memphis.—Freight Traffic Manager E. S. Washburn has been made Vice-President, his former office having been abolished.

Kansas City, Pittsburg & Gulf.—Mr. Ira C. Hubbell has been appointed Purchasing Agent. His duties also embrace the Texarkana & Fort Smith, and Kansas City & Independent Air Line.

Keokuk & Western.—Trainmaster J. P. Boyle has been appointed Superintendent, with headquarters at Keokuk, Iowa.

Lima Northern.—Mr. C. W. Risley has been appointed Superintendent, with headquarters at Lima.

Macon & Birmingham.—Mr. J. R. Lane has been appointed Superintendent of Transportation, Roadway and Machinery.

Missouri, Kansas & Texas.—Superintendent of Motive Power William O'Herin has been made Superintendent of Machinery and Equipment, and will have charge of both the locomotive and the car departments. The office of Superintendent of Car Department is abolished, and Mr. John Doyle has been appointed General Master Car Builder.

Nevada Southern.—R. S. Seibert is Receiver and General Manager, with office at Los Angeles, Cal.; L. Vanderwerker is General Agent for Receiver, with office at Manvel, Cal.

New York & Sea Beach.—Treasurer James T. Nelson has been appointed Receiver.

Florida Southern.—Mr. W. B. Young has been appointed Master Mechanic.

Pecos Valley.—General Manager J. N. Miller has resigned and will be succeeded by Mr. E. O. Faulkner, who has been elected Vice-President and General Manager.

Port Jervis, Monticello & New York.—The following appointments are announced: President, Thomas Waller, Vice-President, George N. McKibben; Secretary, Frederick C. Reed, and Treasurer, S. Harrison Wagner.

Rock Island & Peoria.—Mr. Biram S. Cable has been chosen Vice-President.

St. Louis, Alton & Terre Haute.—Assistant General Manager C. F. Parker has been appointed General Manager.

St. Louis, Kennett & Southern.—L. B. Houck has been appointed Superintendent with office at Caruthersville, Mo.

Seaboard Air Line.—Mr. James Warwick has been appointed General Purchasing Agent.

South Haven & Eastern.—General Manager R. H. England has resigned and will be succeeded by Mr. M. V. Meredith, of Saginaw, Mich., formerly a Division Superintendent on the Flint & Pere Marquette.

Spokane Falls & Northern.—Assistant General Manager Austin Corbin 2d, has been promoted to General Manager.

Southern.—Mr. T. S. Inge has been appointed Master Mechanic at Burlington, N. C.

Terminal Railroad Association at St. Louis.—Yardmaster E. Dunlap has been appointed Acting Superintendent.

Vandalia Line.—President Wm. R. McKeen retired at the annual election. Superintendent J. J. Turner, of the Pittsburg, Cincinnati, Chicago & St. Louis, has been appointed Vice-President and General Manager.

Master Mechanic Wm. C. Arp, of the Pennsylvania Company, at Dennison, O., has been appointed Superintendent of Motive Power, with headquarters at Terre Haute, Ind.

Velasco Terminal.—Mr. L. L. Foster has been appointed Second Vice-President and General Manager.

Wheeling & Lake Erie.—Mr. P. C. Gates has been appointed Acting Purchasing Agent.

Employment.

A young man having a mechanical education is desirous of advancing by means of hard work and is open to an engagement as car or locomotive draftsman. He has a thorough knowledge of car construction, embracing all classes of cars used in passenger or freight service, including sleeping and parlor cars. He has had six years' experience in car drafting, latterly in charge of such work. He has a general and theoretical knowledge of locomotive work but no actual experience. References given. Address "DRAFTSMAN," care this paper.

AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

MARCH, 1896.

CONTENTS.

The Lehigh Valley Railroad is in the market for 2,000 freight cars.

The Delaware, Lackawanna & Western will soon place orders for 1,000 freight cars.

The Central Vermont Railroad Company is having 13 passenger coaches built by Jackson & Sharp.

The Adirondack & St. Lawrence has ordered 10 locomotives from the Schenectady Locomotive Works.

It is stated that the Missouri, Kansas & Texas has decided to build new repair shops at Sedalia, Mo.

The Lake Superior and Ishpeming Railway has ordered 10 locomotives from the Pittsburg Locomotive Works.

An order for 400 ore cars for the Lake Superior & Ishpeming road, has been placed with Wells & French.

The Elliott Car Works, Gadsden, Ala., are building 150 freight cars for the Chattanooga, Rome & Columbus.

The Ohio River Railroad has ordered 300 cars from the Ensign Manufacturing Company, Huntington, W. Va.

The Chicago & North Western has ordered 100 furniture cars from the Haskell & Barker Car Co., Michigan City, Ind.

The Erie has ordered 1,700 cars from the Michigan-Peninsular Car Company and 500 from the Buffalo Car Company.

The Paris Gas Company is putting a Luhrig gas tram car on the Paris Omnibus Company's tramway lines by way of experiment.

The Pennsylvania Railroad Company has ordered the construction of 500 new gondola hopper coal cars at the Altoona shops.

The Wheeling & Lake Erie Railroad has ordered 1,000 freight cars from the Barney & Smith Car Company, Dayton, Ohio.

The Baldwin Locomotive Works has received an order, from the Cincinnati, Jackson & Mackinaw Railroad for five locomotives.

The Great Northern Railway Company is equipping its freight cars with the New York Air Brake Company's latest form of quick action air brake.

Rumors indicate that in the near future the Cincinnati, Jackson & Mackinaw road will give orders for a considerable number of locomotives.

The locomotives under construction in the works of the Grant Locomotive Works at the time of their failure have been completed by Siemens & Halske and are now for sale.

The South Baltimore Car Works has contracted to build 400 freight cars for the West Virginia & Pittsburgh Railroad Company, and 800 coal cars for several coal companies.

The Baldwin Locomotive Works has a contract for 32 additional locomotives to go to Russia. These engines will be 10-wheeled compound passenger engines and will burn naphtha.

The practice of taking the control of heating apparatus on sleeping cars from the porters and putting it in control of the train crew, is extending. Orders were recently issued on some divisions of the Pennsylvania transferring these duties to the trainmen.

The Lehigh Valley Railroad has ordered five heavy locomotives from the Baldwin Locomotive Works. The engines will have 22-inch by 28-inch cylinders, and are intended for service on heavy grades.

The boiler of a locomotive drawing the New York and Philadelphia express train on the Delaware, Lackawanna & Western Railroad exploded near Cassville, N. Y., Feb. 18, killing both the engineer and fireman.

The Brooks Locomotive Works has an order from the Northern Ohio for building six Mogul engines with 18-inch by 24-inch cylinders. These engines are duplicates of those for the Lake Erie & Western, which operates the Northern Ohio.

The Barney & Smith Manufacturing Company, of Dayton, O., will build for C. J. Hamlin, of Buffalo, a private car for the transportation of racehorses. It will be 62 feet long, and will be carried on six-wheeled trucks with steel-tired wheels.

The Chicago & Northwestern Railway is now equipping its freight cars with Westinghouse air brakes at the rate of 25 cars per day. The foundation brakes are at the same time thoroughly overhauled and made to conform to M. C. B. standards.

The New York Central has given an order for 2,150 freight cars, of which the Buffalo Car Company received 1,250, the Union Car Works 500, and the Barney & Smith Company 400. The first two allotments are coal cars, and the last platform cars.

The New York, Chicago & St. Louis has put into service the 10 new freight engines recently received from the Brooks Locomotive Works and the Schenectady Works, and are much pleased with them. They will soon receive three switchers from the same builders.

The 10 mogul locomotives ordered by the Illinois Central from the Brooks Locomotive Works will have 19-inch by 26-inch cylinders, Belpaire boilers 62 inches in diameter, driving wheels 56 inches in diameter and long fireboxes. The total weight of the engine will be about 125,000 pounds.

A policy of rigid economy has been decided upon by the new Atchison management in order to make a saving of at least $1,000,000 a year. President Ripley is making a tour of inspection of that system with the sole purpose of noting the different points where the reductions can best be made. —*San Francisco Bulletin.*

Indian Engineering is authority for the statement that a German has been granted a 75 years' concession for the construction of a carriage road from Teheran to Bagdad. He has also obtained a 90 years' concession for a steam or electric tramway, 10 miles in length, from Teheran to the villages north of the city.

The Monterey & Mineral Belt Railway, of which ex-General Manager Robinson, of the Monterey & Mexican Gulf road, is one of the owners, is to be extended to Matehuala, a rich mining section south of Monterey. The road is now in operation a distance of 20 miles, and is doing a heavy ore business.—*San Francisco Bulletin.*

The new hospital for employees of the Atchison, Topeka & Santa Fe Railroad at Topeka has been opened. It is a large and handsome building, four stories high, and cost about $125,000. The Santa Fe Hospital Association, supported by assessments upon the employees, was chartered in 1891. This association controls this hospital and also those at La Junta and Las Vegas.

The Westinghouse Electric & Manufacturing Company, is equipping the Turtle Creek Valley branch of the Pennsylvania Railroad with an overhead trolley wire to test Westinghouse-Baldwin electric locomotive. This branch runs from Brinton to Murraysville, Pa., and is about 11 miles long. The new locomotive is now at the Westinghouse Electric Company's Works.

The entire Pennsylvania system has adopted the practice of covering the handrails, cylinder-head casings, steamchest casings and other parts of locomotives with paint, instead of giving them a bright finish as has been the custom from time immemorial. The enginemen, it is said, are also required, much to their disgust, to take off the deer horns, stars and other unofficial ornaments that have decorated their engines in the past.

The Pennsylvania Railroad has issued orders for the construction of 38 new locomotives in the Altoona and Juniata shops. Six class "U" switch engines and 12 class "M" switching engines will be built at the Altoona shops, and eight class "L" heavy fast passenger engines and 12 new compound moguls will be built at the Juniata shops. A portion of the switching engines and moguls are intended for lines west of Pittsburg, and five of the new class "L" engines are for the Panhandle.

The *Cosmopolitan Magazine* offers $3,000 in premiums which will be awarded to motor carriages exhibiting the greatest excellence in a trip to be made on Decoration Day, May 30, between City Hall Park and the Cosmopolitan Building at Irvington-on-Hudson. The round trip is about 52 miles. The following points will be considered in making the award: Speed, 50 points; simplicity and durability of construction, 25; ease in operating and safety, 15; cost, 10. Entries must be made before May.

The first official exhibition of the electric motors used to switch the cars on the Brooklyn Bridge was made February 8, in the presence of President Howell, Vice-President J. S. Page and Trustees Keeney and Henriques. The motor car was coupled to three of the ordinary passenger cars, making a train of four cars which was switched by the motors from the incoming to the outgoing tracks and up to the cable sheaves several times. The car made two round trips over the bridge to the satisfaction of the officials present.

At a meeting of the shareholders of the Mount Tamalpais Scenic Railway Company, held early in February, Sidney B. Cushing was elected President; David McKay, Vice-President; Louis L. Janes, Secretary, and the First National Bank of San Francisco, Treasurer. A contract for grading and track laying was let to the California Construction Company and work has already begun. Contracts are about to be let for engines, boilers, dynamos and other requisites for generating power. Work on the power house will be commenced at once.

Some new machinery is being installed in the shops of the car department of the Lake Shore road. At Cleveland a new 105 horse power Buckeye engine having a cylinder, 14¼ by 26 inches, will be put in, and also a No. 2 Fay dimension planer which can dress simultaneously four sides of a timber 20 by 26 inches and reduce the size 2 inches at one passage through the machine. At the Adrian shops a No. 2 Putnam wheel borer will be installed, and at the Englewood shops a No. 7 Greenlee hollow chiselmorticer, with straight and angle boring attachments.

The Lake Shore & Michigan Southern Railway placed car orders last month as follows: With the Michigan-Peninsular Car Company, 500 drop bottom coal cars of 60,000 pounds capacity and 500 standard box cars of 60,000 pounds capacity; with the Madison Car Company, 250 coal cars and 250 box cars; with the Wells & French Company, 250 box cars; with the Union Car Company, 250 coal and 100 box cars, which are to be lettered for the Pittsburgh & Lake Erie and to be delivered prior to May 1. All the other coal cars are also to be delivered prior to May 1, but the box cars are to be delivered during August and September.

Representatives of the Carnegie Steel Company and Bethlehem Iron Company appeared before the Senate Committee on naval affairs last month to protest against the enactment of Senator Smith's bill providing for the erection of a government armor-plate plant in Washington. These companies asserted that to equip such a plant would cost more than $4,000,000, and they argued that in view of the fact that immense sums had been invested by private persons in this business at the suggestion of the Government, it would be unjust for the Government to render that outlay useless by the construction of competing works that could do the work no better and no cheaper.

The annual report to the stockholders of the Chicago & Alton Railroad, issued last month, shows the net earnings for 1895 to be $2,819,493, an increase of $155,944 compared with 1894. President Blackstone, in the report, takes occasion to declaim against what he terms popular control of railroads. He sets forth that the Supreme Court of the United States long ago held that the charter of a railroad corporation is a contract within the meaning of the contract clause of the constitution, but that the people have failed to remember their side of the contract. One of the provisions of such contracts is that railroads shall always have power to collect reasonable rates, but the state has passed a law enabling a state board to limit railway rates at their discretion.

It is reported that successful arrangements for preventing damage to merchandise through excessive cold have been experimented with on a German railroad. The winter 1894-5, which was particularly severe throughout Central Europe, caused great losses of perishable freight in transit during the winter months. It was, therefore, proposed to heat freight cars carrying such goods. A stove in the center part of the car, which is fed from without, supplies the necessary warmth, and a thermometer, which is visible from the outside, reveals to the inspector, whose duty it is to ascertain the temperature of each car at every station, whether he has to open the ventilators on top to reduce the heat or whether new fuel ought to be introduced to keep up the fire and increase the temperature. A slight additional freight is charged, and as the shippers prefer this increase to the uncertainty of the weather, the entire system is said to have been pronounced a success on all sides.

Bradstreet's, in reviewing the gross earnings of railways in January, 1896, had the following to say regarding the large increase: "January gross earnings may be classed as very satisfactory, showing as they do a continuance and accentuation of previous favorable conditions and the practical disappearance of many unfavorable features which have marked gross earnings reports for the past few months. The total earnings of 126 railroads for January aggregate $37,761,005, an increase over January a year ago of 11.3 per cent., this large gain being made on a total of 92,766 miles, an amount which may be regarded as truly representative of the country's operated railroads. Not only is the gain shown in January in excess of that recorded for some time past, but the number of large increases is larger and decreases are smaller in number and in volume than for many months past. In fact, the month just closed makes a very welcome showing as regards the small number of decreases and the trifling volume of the declines shown from January a year ago."

Communications.

The Westinghouse Air-Brake Company versus The Boyden Brake Company.

Editor American Engineer, Car Builder and Railroad Journal:

The issue by the Boyden Brake Company of a circular dated December 31, 1895, in which that company asserts, among other misleading statements, that the decision of the Fourth Circuit Court of Appeals in favor of that company is *final*, makes it necessary for us to state that the United States Supreme Court has, upon petition of our counsel, based upon a few of the serious errors involved in that decision, granted a writ of certiorari directing the case to be sent up to it for revision and final judgment.

The Boyden Company's statement was manifestly prepared before the Supreme Court granted the writ of certiorari, and it will thus be seen that that company is not yet finally authorized to make and sell quick-action air brake, without liability for infringement of our patent rights.

We have never doubted that the final decision in this case will reaffirm the validity of our pioneer quick-action air-brake patent (No. 360,070, the one in dispute,) as already established in other courts; for Judge Hughes, in his decision in favor of the Boyden Brake Company, says:

"That this invention of Westinghouse, thus undefined (the Court then referring to the second claim), is one of the highest value to the public, and that it is a pioneer one in the art of quick action brakes is not denied, and is conceded. It is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal protection from the courts in construing the claim."

A statement in accord with the opinions of the other courts which have, in each instance, conceded and affirmed the pioneership and value of this invention.

In each of the three previous decisions in favor of this patent, the second claim has been upheld and has not, in any manner, been held to be insufficient, even in any technical sense, to fully cover the invention; and we therefore the more strongly feel that our confidence in the ultimate determination of this litigation in our favor is well founded.

The Boyden Brake Company has issued an illustration and description of a new form of quick action triple valve, which it states was subjected to a satisfactory rack test at Altoona, by the air-brake committee of the Master Car Builders' Association. This new valve has not hitherto been the subject of litigation under our patents and has never, to our knowledge, been commercially used or tested. We believe that the construction of this valve comes clearly within the claims of one of our patents, and we have promptly brought suit against the Boyden Company, to restrain that company from making and selling this new valve.

It will not be out of place to call attention to the fact that railway companies have, in numerous instances, been misled by the statements of various parties manufacturing brakes, in infringement of our rights, and the loss inflicted upon those who have purchased brake apparatus in reliance upon those statements has already been very great. We feel convinced that we are fully justified in believing that our patents fully cover all of the forms of quick-action brakes which have so far been offered for sale, and that the courts will finally so decide.

The Westinghouse Air Brake Company,
H. H. Westinghouse, General Manager.
Pittsburgh, Pa., Feb. 1, 1896.

Laird Crossheads.

Editor American Engineer, Car Builder and Railroad Journal:

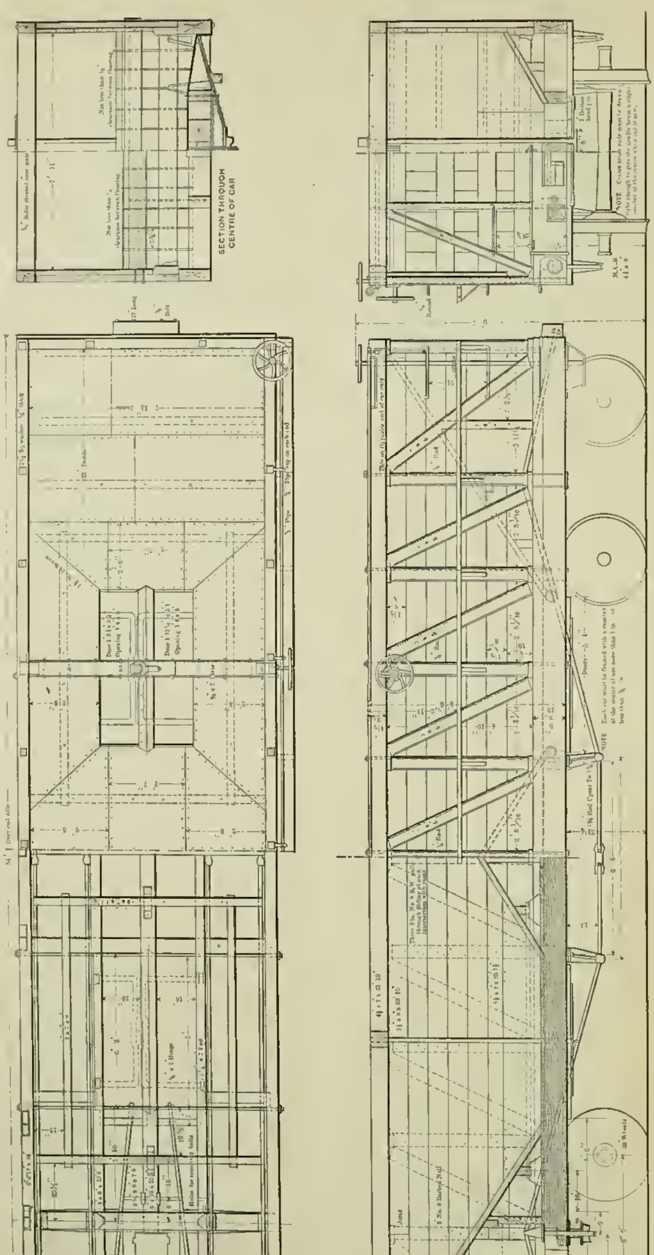
I saw recently a rather ponderous explanation in some railroad paper as to why piston rods of Laird crossheads break so often. The explanation was that it was due to the center of gravity of the crosshead being so far above the piston-rod, thus forming in action an overhanging and unbalanced weight that tends to bend the piston rod. The real cause is that the thrust of the piston acting on the short lever of the crosshead tends to rock it and force apart the guides. The wear is more rapid than with the four-bar guide because of this tendency to rock the crosshead, and therefore it is simply a question of increasing the wearing surface. Why are such self-evident facts neglected by a technical paper?

It is clear to any one who will examine the matter that the whole trouble is due to a want of wearing surface on the crosshead to resist the action mentioned. This constant effort to separate the guides wears the crosshead wings rapidly and the unbalanced overhang of the crosshead alone would not bend the rod in a hundred years. Laird guides are often convenient if not necessary in certain cases, and should be designed with the distance between guides and piston rod as short as possible and with an increase of guide surface.

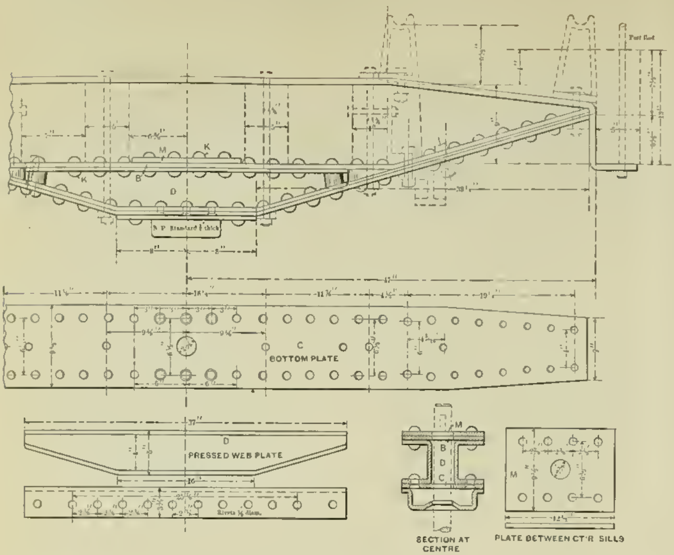
The erroneous explanation of the technical paper mentioned has, I find, been accepted by some master mechanics, who by lightening the crosshead have attempted to correct a fault which does not exist, and in more than one case ended in broken crossheads and wrecked cylinders.

G. A. Harwood.

[Our correspondent is apparently quite sure of his position, but he has fallen into the error of greatly underrating other people's thinking apparatus. Many close students and practical men whose opinions are respected have at various times in the last five years charged the frequent breakages of piston rods attached to Laird crossheads to the inertia of the unsymmetrical weight of the latter. Their arguments have been presented so many times that there is no occasion for us to repeat them now. The argument of our correspondent lacks clearness and force and is hardly strong enough to support his position.—Ed.]



Twin-Hopper Gondola Car of 70,000 Pounds Capacity—Northern Pacific Railroad.



Body Bolster for Gondola Car of 70,000 Pounds Capacity

Twin-Hopper Gondola Car of 70,000 Pounds' Capacity—Northern Pacific Railroad.

Several roads have built coal, ore, or other special cars to carry 70,000 pounds, but we believe that the Northern Pacific Railroad is the first to get out drawings for standard box, flat, and gondola cars of this capacity. Their box car is 41 feet long inside, 42 feet long outside of the end sills, 0 feet 1 inch wide over the sills, 6 feet 6 inches wide inside, and 7 feet 10 inches high in the clear. The flat car is 41 feet long, and the gondola car 34 ft. long. This last-mentioned car we illustrate through the courtesy of Mr. John Hickey, Superintendent of Motive Power.

As will be seen from our illustrations, the car has twin-hoppers, the slopes of which are such as to leave no level floor space, consequently the car can be emptied without any shoveling whatever. The sills of the car are five in number, one center sill 6 inches by 10 inches, two intermediate 4 inches by 9 inches and two side sills 5 inches by 13 inches. The center sill falls short of the end sills, extending barely through the body bolsters. From the bolsters to each end sill its place is taken by two timbers, 5 inches by 6 inches, to which the draft gear is attached. The drawbar is thus in the same horizontal plane as the sills.

The side framing is strong and evidently able to carry a large part of the entire load. The plate at the top of the sides is 4½ inches by 7 inches and the posts and braces are heavy. The bottom side plank is 3 inches by 10 inches and the others 1¾ inches by 8 inches. The sides are 5 feet 5 inches high above the tops of the sills and 6 feet 6 inches high from the bottom of the latter. In addition to this framing there are two truss rods of deep camber 1⅝ inches in diameter with ends upset to 1⅞ inches. The needle beams are 6-inch channels weighing 12 pounds per foot.

The framing around the hoppers is clearly shown on our engravings. The hopper door openings are 5 feet long and 1 foot 4 inches wide on each side of the center sill. The doors are of unequal width so as to bring their edges to one side of the sill. They are raised into place by chains that wind up on to a shaft under a timber extending across the car and secured to the tops of the sides. The hand wheel at the side of the car is for operating this shaft. The doors are locked in position by a rod suspended from the cross-timber just mentioned and having a large T-shaped head at the lower end. This head is inserted in a slot between the doors and the rod given a quarter-turn, after which it is held from further turning by a latch that drops over its upper end which has a square on it for that purpose. The construction is shown in the plan and elevation of the car.

The bolster is of metal and very strong. The same design is employed for all of the three classes of 70,000-pound cars mentioned in the early part of this article. It consists of a top plate 7 inches by ½ inch in section, and two plates in compression, each of which is 9¼ inches by ½ inch in section at the center, but beginning outside of the intermediate sills are gradually narrowed to 7 inches at the ends. Between the ends of these plates there are filling pieces ½ inch thick, three inches wide and 34½ inches long, and at the middle they are separated by two pressed steel pieces of channel section 5 inches deep and 37 inches long. This makes a very substantial bolster, and one that if carefully fitted at the ends should be very stiff.

The center plates are pressed steel, and the Fox pressed steel truck is used under all of these cars. The body of this car weighs about 18,000 pounds, and the trucks about 12,000 pounds, making the total weight 30,000 pounds.

Motor Trucks and Motors for the Lake Street Elevated Railway, Chicago.

The Lake Street Elevated Railroad, in Chicago, is at present preparing its tracks for the change from steam to electric traction, and has ordered a total of 60 motor trucks from three different manufacturers. The McGuire Manufacturing Company, of Chicago, will furnish 50 of these; the Baldwin Locomotive Works eight, and the J. G. Brill Company, of Philadelphia, two trucks. The motors are to be furnished by the General Electric Company, and of the class known as "G. E. 2,000."

The cars under which the trucks will be put, are of the usual size for elevated railway traffic, being about 39 feet long over the bodies, and 46 feet long over the platforms. When fully loaded the weight above the trucks will be about 38,000 pounds, and each motor weighs about 4,200 pounds. The weight of the trucks varies somewhat with the different designs.

We present to our readers engravings made from photographs of the trucks built by the McGuire and Brill companies. The McGuire truck shown in Fig. 1 is a substantial looking piece of mechanism. It is provided with double equalizing bars cushioned at the boxes to which are secured two crossbars or transoms.

The motors are supported at the axles and also by attachments to these transoms. The springs over the journal boxes have only one inch motion after receiving their normal load. The parts mentioned maintain a constant relation to each other and are independent of the spring arrangement for the car body.

The arrangement of parts supporting the car body is peculiar. The side frames, which are of malleable iron, contain pedestals for the journal boxes in which the latter are so fitted as to permit 1¼ inch lateral motion each way. Each frame rests on coil springs on the equalizers and has a large bracket or shelf on the inner side to receive the end of the truck bolster. Under this shelf is a double elliptic spring supported by a spring plank suspended from the transoms by swing links. The two side frames and bolster may therefore be considered a unit resting on four coil and two double elliptic springs and having a swing motion of 1¼ inches each side of its normal position. The great advantage of this arrangement lies in the fact that the load is hauled by the truck through the medium of side frames and bolster which are rigidly connected together.

The brakes are located inside the wheels, making a short, compact truck, occupying the least possible space under the car and making the truck frame less liable to damage in case of accident. There is no brakebeam, the brakes on one side being independent of those on the other side of the truck, but having the pull rods leading from the upper ends of the levers perfectly equalized. The brakes are suspended from the truck frame by patent elastic brake hangers, which form brake heads, brake hangers and adjustable release springs all in one, and at the same time take up their own lost motion, preventing all chattering and kicking of the brakes which is so common a fault of swinging brake hangers.

These trucks are quite similar to those furnished by the same company for the motor cars that are being tried on the Brooklyn Bridge.

The truck of the Brill Company is shown in Fig. 2. The side frame is cast in one piece, and the oil-boxes have extensions cast on their under sides, into which the ends of the equalizer bars are inserted. These equalizers are perfectly straight bars, and are partly hidden in our illustra-

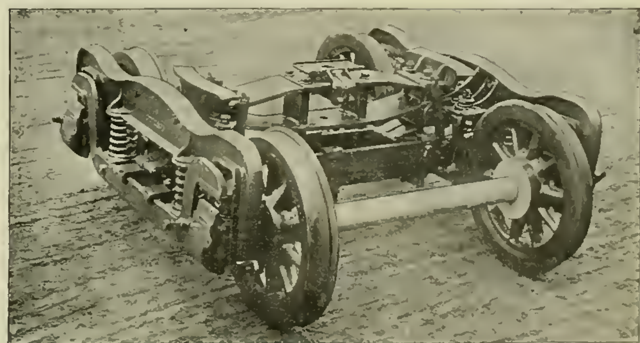


Fig 1.—Motor Truck Built by McGuire Manufacturing Company for Lake Street Elevated Railway.

Fig. 2.—Motor Truck Built by J. C. Brill Company for Lake Street Elevated Railway.

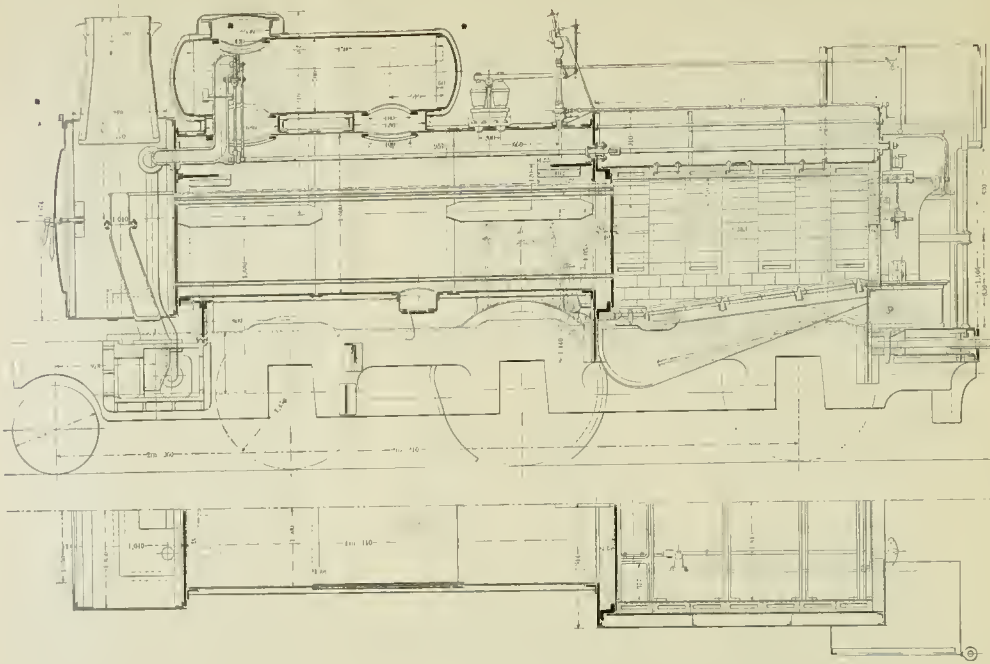


Fig. 1.—Locomotive with Firebox Lined with Firebrick—Doctem System.

tion by the bottom bar of the side frame. The coil-springs rest on them, and, by the special construction employed, are placed nearer the journal boxes than is possible ordinarily, and thus prevent much of the tilting of trucks from the application of the brakes. The usual transoms, spring planks, elliptic springs and swing bolster complete the truck. The brakes are outside hung. The construction is exceedingly simple

Fig 3.—Motor "G. E. 2000" for Lake Street Elevated Railway.

The wheels for all of these trucks are 33 inches in diameter outside of the tires, with cast-iron spoke centers and Krupp tires secured by retaining rings. They weigh about 800 pounds each. The axles have 4¼ by 8-inch collarless journals. The wheel base is 5 feet 6 inches.

The motors, which we have already stated are known as "G. E 2,000," occupy a space 53 inches wide, 33 inches high and 25 inches from the axle to the end of the motor. There are two of them on each truck, and they are geared so as to develop a speed of 40 miles per hour.

A general view of one of them is given in Fig. 3. It is designed for a drawbar pull of 2,000 pounds when mounted on 33-inch wheels. For its power, its weight is comparatively light. The armature is of the "barrel" type, a method of construction which allows of the ready repair of a damaged conductor. The iron-clad construction of the armature, so conspicuously successful in other motors by the company, is followed in the G. E. 2,000.

The design and installation of the electrical equipment of this road is in charge of General Superintendent Hedley and Chief Engineer C. V. Weston.

Harper's Weekly of February 29 contained an interesting and fully illustrated article on "How Long and Lofty Bridges are Built." Some of the great engineering triumphs in this direction were described.

Note Upon Fireboxes With Firebrick Walls *

DOCTEUR SYSTEM.

It does not seem to me to be out of place to briefly review the history of the construction of locomotive boilers, intended to accomplish the object which I have had in view for a number of years, when I proposed to the management of the State Railways of Belgium to make a test of a firebrick furnace and of building a trial boiler on my system

The first locomotives hauling passenger and freight trains on the Manchester & Liverpool line (1826 to 1828) had iron fireboxes, and were fired with coke. These fireboxes were built of the materials procurable at the time, that is of high-grade materials, of whose actual quality we have no idea. Nevertheless, the shop superintendent of the line met so many difficulties in the maintenance of the engines and the running was so irregular that he proposed to Stephenson to substitute red copper for iron in the fireboxes, the sheets of copper being likely to last indefinitely, and then, after they had been removed from service, still having considerable value.

So the iron fireboxes were replaced by those of copper, and it is only under exceptional conditions that we have reverted to the former

The red copper tubes that were in use at the same time were abandoned and brass substituted in their place, because the copper was so rapidly scored by the coke. As a general thing, the life of the copper tubes ranged from six to eight months, while those of brass could be kept in service from two to three years.

Afterward charcoal and homogeneous iron tubes were used where the feed water was comparatively pure; that is to say, from 18 to 20 degrees Beaumé With coal the use of copper tubes has been resumed, and tubes of this kind are now being tested on the State Railway of Belgium, and they appear to be giving satisfactory results

Likewise smokebox tube-sheets of copper are behaving very well in service.

But the high price of these materials adds very considerably to the cost of the boilers, and this, together with the value of the sheets held in stock for repairs, locks up a good deal of capital.

It was in order to avoid this increased expense that I have attempted to design a locomotive boiler at the lowest possible cost, while still retaining the copper tube sheet in the firebox which the use of our ordinary fuels imposes upon us, and of forming the sidewalls and back of the firebox of refractory material which has been shown to have such a favorable influence upon combustion.

I did fear a loss resulting from the almost total suppression of the direct heating surface and the consequent reduction of the evaporating surface, the latter not even retaining the crownsheet Experience has shown that my apprehensions on this second point were entirely without foundation.

To compensate for this partial suppression of the direct heating surface, I increased the diameter of the shell so as to be able to increase the number of tubes used, the boiler built after my plans having 330 tubes.

I was thus sure of having an excess of heating surface and of being able, without injuring the regularity of the service to be rendered by the locomotive, to plug a certain number of the tubes in order to determine whether the direct heating surface has the important influence that has been attributed to it up to the present time.

In order to compensate for the loss of steam space resulting from the removal of the shell from over the firebox, I

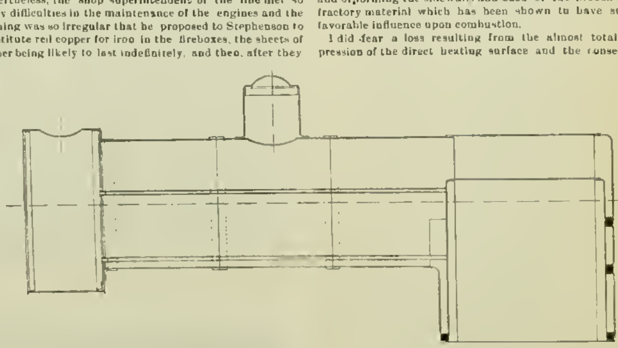


Fig 2 Original Boiler in Experimental Locomotive

* From a paper by M Docteur published in the *Revue Universelle des Mines*.

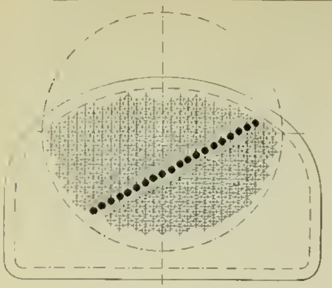


Fig. 3.

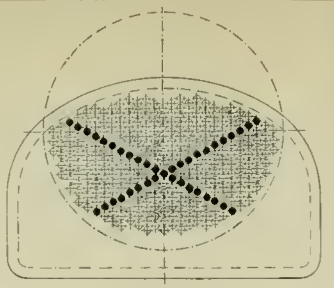


Fig. 4.

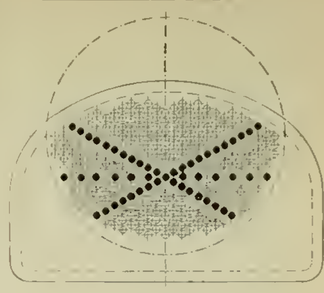


Fig. 5.

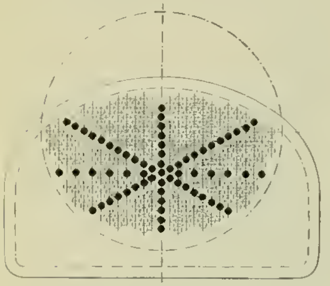


Fig 6.

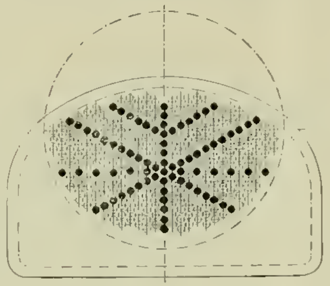


Fig. 7.

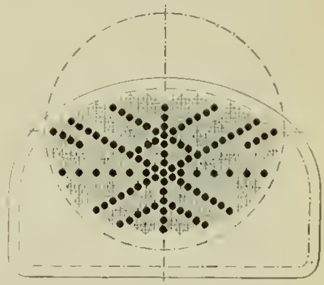


Fig. 8.

Diagrams Showing Tubes Plugged in Experiments on Amount of Tube Heating Surface Required with Firebrick Firebox.

have put a steam drum on the boiler at the front end The cubic contents of this drum are about 24¼ cubic feet more than the steam space of ordinary boilers, including that of the shell, above the crownsheet and the dome.

The supplementary drum is provided with manholes through which the boiler can be entered, and by which the throttle and dry pipe are rendered accessible. Fig 1 shows the arrangement and appearance of a locomotive fitted with this new boiler

It was important to definitely ascertain whether a wall of firebrick could be maintained in the firebox of a locomotive, to note the durability of such a wall in service and to make sure of the circulation of air about the bricks, as much for the purpose of keeping them cool as to make a delivery of hot air above the grates.

The results obtained prove that it is sufficient to increase the indirect heating surface by an amount equivalent to the direct heating surface suppressed in order to obtain a production of steam at least equal to that obtained under the original conditions; in fact, when the heating surface was reduced to that of the old boiler by the plugging of the tubes, there was no change in the regularity of the working of the engine. Therefore one square foot of direct heating surface has no more influence in the production of steam than the same amount in the tubes.

The tests of the new firebox with firebrick walls were made on locomotive No. 512, with outside cylinders and having the following principal dimensions:

Diameter of cylinder	19.1 in.
Stroke of pistons	26 in.
Steam pressure per square inch	142 lbs.
Diameter of driving wheels	4 ft. 11⅛ in.

Figures 1 and 2 show the outline of the old and new boilers.

The locomotive fitted with this new firebox was sent out from the Luttre shops on Feb. 20, 1894 From that time it has hauled trains Nos. 4,873, 3,874, 1,805, 3,331, 3,330, 4,163, 4,164 on the line running from Luttre to Brussels and Antwerp and back by way of Braine-le-Comte and also the trains running between Luttre and Tournai.

Care has been taken to keep an account of the production of steam in the new boiler, the consumption of coal by the engine, as well as the life and strength of the firebrick. Locomotive No. 512, coupled to the trains cited above, has hauled the load of a freight locomotive and the boiler has always furnished steam in sufficient quantities to insure the running of the trains without stalling or delays.

The results of the different tests to which it has been subjected show that the new boiler gives very satisfactory results when taken from the standpoint of the evaporation of water and that this evaporation sometimes amounts to from 8½ to 9 pounds of water per pound of coal burned when hauling through trains with a light load.

The combustion of coal in the firebox is perfect: this is due, in the first place, to the high temperature which is maintained in the firebox, whose walls are not constantly cooled by contact with water, as in the firebox of ordinary boilers; and, secondly, to the fact that the hot air which is admitted above the bed of coal that is burning upon the grate suffices to burn all the gases arising therefrom.

Furthermore, there are never any black spots upon the grates; when the coal is thrown in it is at once raised to such a temperature that it becomes incandescent immediately, and its gases are not distilled from it, as in the case of other fireboxes.

The temperature of the gases on entering the smokebox never exceeds 750 degrees Fahrenheit at a few inches from the tube sheet, as in the best freight locomotives

There are fewer cinders in the smokebox than in the ordinary boilers, they are much finer and comparatively cooler.

The production of carbonic oxide is avoided; the flames developed in the firebox are always clear and evenly distributed over the whole surface; the production of heat in the

TABLE NO. I.

Date of Test.	No of trains hauled.	Consumption		Vaporation of water per kilo. of coal used.
		Of Water in liters	Of Coal in kilograms.	
March 1.	3331	1,552	650	10,00
	1804	7,128	850	7.50
" 3	4873	4,697	650	7 22
	4874	8,701	1,200	7.25
" 6	4873	4,389	600	7.31
	4874	8,239	1 100	7 19
" 9	4873	6,160	850	7 21
	4874	7,351	1,050	7 45
" 11...	4874	6,282	750	8.25
	1874	7,084	850	8.33
" 16	4873	4,740	675	7 00
	4874	8 930	1,100	8 11
" 20	4805	3,773	475	7.90
	3330	5,383	750	7.17
" 21	4873	4,513	600	7 57
	4874	5,994	750	7.99
" 23	4873	5,600	750	7 46
	4874	8,208	1,000	8.20
" 27	4163	9,702	1,050	9 24
	4164	16,863	2,050	8 22
" 28	4873	6,008	700	8.58
	4874	7,161	850	8 42
" 30	4873	4,367	600	7 30
	4874	8,165	950	8 51
April 3	1805	4 881	650	7 50
	3330	5,330	675	8.28
" 4	4873			
	4874			
" 5...	4805			
	3330			
	3331			
" 7. .. .	4805			
	3330			
	3331			
" 10	4805			
	3330			
	3331			
" 11	1873			
	4874			
" 14	3331	4,312	600	
	4804	5,390	750	

Note. — There were 20 tubes plugged on trips of March 23 and 27, 39 plugged on the 28th and 30th, 51 on April 3, 64 on April 4, 5 and 7, 76 on the 10th, 100 on the 11th, and outbound trip of the 13th, while on the return trip of the 13th the admission of air above the fire was cut off.

TABLE NO. II.

Time of test.	Run of the locomotive in kilometers	No. of actual units hauled	Consumption		Total.	Allowance of fuel.	Consumption	
			Of bituminous coal	Of fine coal.			Of coal per kilometer.	Per virtual unit hauled.
February	339	25.984	1 600	3 000	4 600	7.815		
March	1 462	119 888	8 600	16.400	25 000	33 444		
April . ... jusqu'au 13.	855	68 776	3 000	9 600	12.600	17 707		
	2 656	214 648	13 200	29.000	42 200	59 866	15.88	0 19

Saving 17,6?5 kilometers, or 33 per cent

firebox is very great and still the loss of heat due to radiation should be small on account of the firebrick sides, which have a thickness of 3.94 inches, besides a current of air passing around the bricks; also, the sheet metal covering that is outside the bricks has a lower temperature than that covering the ordinary firebox; it is possible, without any danger of being burned, to place the hand on this jacketing over the firebox of locomotive No. 512.

The admission of hot air, which circulates between the two parts and in the passages of the double wall, forms a perfect smoke preventative regardless of the quality of the coal used. For example, the new firebox has been fed successively with Fleuu coal for furnace use, forge coal, pure semi-bituminous coals and a mixture of semi-bituminous and fine coal and in every test it was almost impossible to distinguish any difference in the haze of smoke issuing from the stack while the train was in motion

The new firebox was fed with a mixture of three quarters of fine coal and one-quarter of coking coal, and under these conditions 8 pounds of water was evaporated per pound of coal (see table I,); 8½ to 9 pounds of water have also been evaporated per pound of coal, as we have already said; in hauling through freight, when the firebox was always at work, the evaporation has risen above 9 pounds.

The coal consumption of engine No. 512, when it had its old boiler with a small deep, firebox using, on an average, the best quality of coal, has always been more than 80 pounds to the mile, while with the new boiler it dropped to 54½ pounds on a run of 11,700 miles.

There is another advantage possessed by the new firebox—the draft through the bed of coal is very much reduced by the hot air entering through the openings in the walls and when it comes into the firebox above the bed of coal, the result is that the coal is not carried into the smokebox and that it is even preferable to use lighter and finer coal.

The gases, although raised to a very high temperature in the firebox, seem to have lost much of this heat after passing through tubes 13 ft 1½ in. long; in fact neither the smokebox nor its doors have ever been brought to a red heat by the temperature of the products of combustion.

Table No. 1, shows the trains hauled by the locomotive fitted with the new firebox, as well as the consumption of coal and water that has been observed during the experiments

Table No. 2, gives: (1) the total amount of work done by this locomotive during the tests, (2) the total consumption of coal during the same period; (3) the allowance of coal attributed to the engine for the work which it has done.

The results given by these figures are very satisfactory, and can only be attributed to the change in the boiler; in fact, tests made in 1891 on the average working of the same locomotive with its old boiler are entirely unfavorable to its use.

All metal parts entering into the construction of the new boiler are in perfect condition up to the present time; no defects and no weakness have been detected even in the smallest pieces of the shell, and this is especially true of the firebox tube sheet, the special ring holding this sheet, and the different portions of the drum, etc. The water gages, the throttle lever and rods, although put in front of the firebox as in other locomotives, have given no trouble in handling and have given no annoyance to the driver

Experiments have also been made with the boiler for the purpose of determining the effect of the direct heating surface of the firebox, and how many square feet of heating surface in the tubes should be used to replace one square foot of heating surface in the firebox. In the course of our experiments with the locomotive having the new boiler we have plugged in succession, 20, 39, 51, 67, 76, and even 100 tubes. The engravings (Figs. 3, 4, 5, 6, 7 and 8) show the tubes that were plugged.

These tests have shown that with 76 tubes plugged, the locomotive is capable of supplying sufficient steam to haul the regular train assigned to freight locomotives on the line over which it was run.

The heating surface, before the plugging of the tubes, was:

15.57 square feet in the firebox
1,707.21 " " " tubes.
1,722.78 " " total heating surface

After 76 tubes had been plugged the heating surface was:

15.57 square feet in the firebox.
1,283.22 " " " tubes
1,298.79 " " total heating surface.

The figure is practically the same as the total heating surface of type No. 25 on the Belgian State Railway, which is 1,299.06 square feet, divided as follows:

1,176.75 square feet in the tubes.
122.31 " " firebox.

From this we can conclude that the difference in the production of steam between the direct and indirect heating surfaces of locomotives is inappreciable. In further confirmation of this we obtain the same result by comparing the heating surface of the old boiler of locomotive 512 with the heating surface of the new boiler after 76 tubes had been plugged, in fact the heating surface of locomotive No. 512 fitted with the old boiler was 1,263.24 square feet, distributed as follows:

1163.43 square feet in the tubes,
99.81 square feet in the firebox

It should be remembered that the production of steam in this last boiler was always insufficient for the work that it had to do.

Finally we would call attention to the last tests made with the new firebox, where the draft of air through the walls was entirely stopped, these experiments showed an instant diminution in the production of steam, an increase in the consumption of coal, and a far less perfect combustion of the fuel in the firebox.

The use of refractory materials in the fireboxes of tubular boilers demands special care in the installation, the necessity for which was recognized at the time the boiler was fired for the first time, which was upon Dec. 15, 1893, and before all the work upon the engine, such as placing the jacketing, etc., had been completed.

It is important that the admission of cold air should be avoided to as great an extent as possible, when the bricks are heated to a white heat, and that the fire should not be hauled immediately after ending a run, but should be allowed to die out gradually

It has been stated that in proceeding in this way the steam pressure will be maintained for several hours

Steam has always been raised, even from cold water, in one and a half hours, while, with the ordinary boilers, it requires at least three hours.

The expansion of the shell has been measured with great accuracy by means of points on the frame, and it has not exceeded from .15 to .20 inches.

We may consider that this boiler is perfectly safe, for it consists of a cylindrical shell and tube sheets braced by the tubes as well as by re-enforcing sheets and ties. The tube sheets were found to be perfectly flat after a run of 11,625 miles.

Finally, this boiler effects a considerable saving in invested capital, as compared with the boiler of an ordinary freight locomotive having approximately the same dimensions; the saving is estimated at 5,000 francs ($1,000) per boiler.

Expense of a complete renewal of the brickwork (materials and labor) does not exceed 100 francs ($20) and can be done by an ordinary mason in three days.

It should be remembered that the expense of merely replacing a few staybolts in an ordinary boiler frequently exceeds this amount. Furthermore, by the use of this new type of boiler, a saving of from 10 per cent. to 12 per cent. in fuel can be made when air is admitted above the grate.

Construction and Maintenance of Railway Car Equipment. III.

BY OSCAR ANTZ.

(*Continued from Page 22.*)

DRAFT GEAR.

The draft gear of freight cars is subjected to greater strains and more abuse and has been the cause of more loss of life and of more injuries to railroad employees than perhaps any other part of railroad equipment. It is therefore but natural that it has received considerable attention and has been the subject of many experiments which have resulted in numerous inventions and designs of more or less merit. The danger attendant to the coupling of cars by the link and pin has been made manifest to the general public by the numerous accidents to railroad trainmen, resulting in loss of life or limb, and the desire to invent some kind of automatic coupler which would not necessitate going between the cars to couple and uncouple has been a favorite one with many who otherwise had but little idea of practical railroad work. Naturally, many of the resulting designs are not of practical value when put into actual service, even though there may appear to be some merit in them when in the shape of models.

The great majority of the car couplers invented have never been put into actual use, and even those that have proved successful and have been adopted or put into extended use are so numerous that it would be impossible in this article to describe them; and no attempt will be made to do it; a general description of some of the types in common use only will be given.

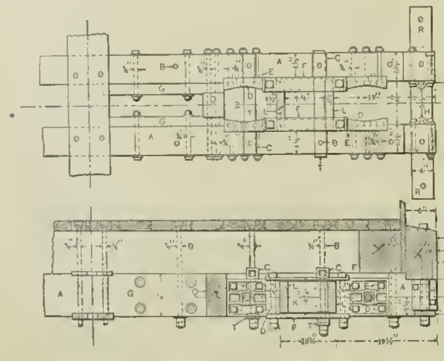
The draft gear can be considered as consisting of two distinct parts, viz., the coupler or drawbar, which connects the cars together, and the drawbar attachments which connect the drawbar to its own car and transmits pulling and buffing strains to the framework.

The drawbar itself can be considered as consisting also of two distinct parts, the front or coupling part, which couples with another drawbar and the rear end or shank, by which it is connected to the draft gear of its own car. The front end is independent in its design on the method of attachment at the rear end.

The M. C. B. Association has adopted as standards certain sizes and relations of parts of the drawbar, without recommending any one particular construction, the type adopted being the so-called vertical plane coupler, which does not require the use of a link and pin. Only the outline of the parts which come in contact in coupling are laid down, the details of construction being left to the individual judgment of the inventor or car builder. This contour line is shown in full lines at *X X* in Figs. 15 and 16, and some of the couplers will be described in detail in a future article.

The drawbar attachments on the frame of the car, while they vary greatly in detail, still have some general points of resemblance, and may be described as consisting of lugs or stops attached to the center sills (either direct or through the intervention of draft timbers), against which large washers or plates are placed, and to which are transmitted the pulling and buffing strains of the drawbar, springs being introduced to lessen the shocks.

Attempts have been made to have other parts besides the drawbar adopted as standards, but there is such a vast diversity of opinions, that as yet no design has been made which meets the approval of all or even a majority of the car builders. The nearest approach to uniformity which has been made is the recommendation by the M. C. B. Association of a certain design which is considered as good practice. Many roads have draft gears which approach very closely to this design, the variations being principally in the details, and while the design has not been adopted exactly as submitted by any road, some of them are putting a draft gear on all their new cars which uses the castings and sizes of iron, bolts and timbers and the general arrangement recommended, some slight variations being made in minor details to conform to the general practice of those particular roads. A description of this recommended draftgear can therefore be considered as covering quite a number, if not a majority of the draft gears in use on freight cars in this country.



Figs. 12 and 13

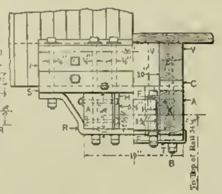


Fig. 14.

Draft Gear for Freight Cars Recommended by the Master Car Builders' Association.

Figs. 12, 13 and 14 show three views of this draft gear as attached to the frame of a car, the drawbar and rear end attachments, with exception of the follower plates being omitted. Figs. 15 and 16 show the drawbar, with the two most common styles of rear end attachments,

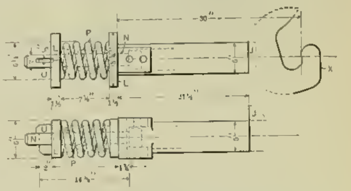


Fig 15.—M. C. B. Standard Coupler with Tail Pin.

either of which can be used with the above draft gear without any changes. The draft timbers *AA* are of oak, 5¼ by 8 inches in section, and are fastened securely to the center sills by means of ¾-inch bolts, *BB*, which have double nuts on the bottom, the heads resting in cast-iron socket plates let into the floor. When the center sills do not come directly over the draft timbers, they can be furred out by bolting pieces to their sides, to obtain solid timber for the bolts to pass through, and to get a good bearing for the draft timbers, as shown in dotted lines at *VV*, Fig. 14. To resist displacement and to relieve the bolts of some of the strains, cast-iron key blocks, *CC*, are inserted between sills and draft timbers, being let into each and held in place by bolts passing through them. With iron body bolsters the rear ends of the draft timbers are usually passed through between the two members, with shoulders against these, and extending about 18 inches or 2 feet beyond; stiffening pieces are then added to fill up the space between the ends of the draft timbers and the crosstie timbers. When wooden body bolsters are used the ends of the draft timbers are fitted against these.

The front ends of the timbers pass under the end sill and, when wooden face blocks are used, these drop down below the end sill about 1½ inches and the draft timber is cut away the same amount, forming a shoulder.

The inside of each draft timber is cut away 1 inch for a certain distance, and against the shoulders thus formed, the cast-iron drawbar stops *DD* are fastened. There is quite a variety of these castings, of all shapes and sizes, and the ones shown are about as strong and heavy as any in use; they are fastened to the draft timbers by five ⅞-inch bolts the heads of which are next to the casting and are prevented from turning by ribs on the casting; the nuts rest on plate washers and are prevented from turning by pieces of hardwood nailed to the timbers, which can be easily removed in case the bolts have to be taken out. To further secure the castings, lugs, ⅞ inch square in section and 6 inches long, *EE*, are cast on the back and let into the draft timbers. Cylindrical lugs of about 1 inch in diameter are sometimes used instead, but they are broken off easily and are therefore not very reliable. There are two castings to each timber, one to take the pulling and one the buffing strains. The two castings are connected together on top and bottom by wrought iron drawbar-guides, *FF*, which transmit some of the strains from one to the other, and also act as a guide to the follower plates. They are made of ½ by 2½-inch or ⅝ by 2-inch iron and are fastened to the castings by ¾-inch bolts. When no timber comes directly over these bolts the top guide is turned up at the ends to prevent the bolts from turning, the bottom ends being provided with lock nuts. When there is a timber above them the bolts are carried through this and the floor and their heads rest in cast iron sockets let into the latter.

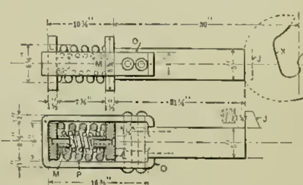


Fig. 16.—M. C. B. Standard Coupler with Strap.

The draft timbers are sometimes re-enforced by additional timbers, *GG*, placed between the back drawbar stop and body-bolster and tied to them by ¾-inch bolts; these timbers take some of the buffing strains.

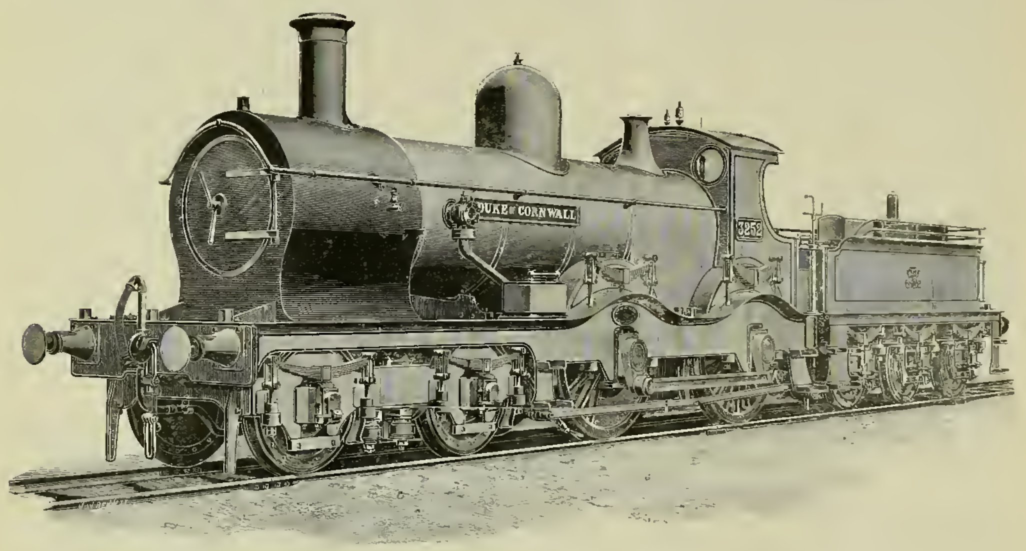
The two draft timbers are tied together back of the drawbar stops by two ¾-inch bolts passing through from one to the other, through a distance piece, *QQ*, 4 inches wide, fitted between the timbers or the re-enforcing pieces. Other ties, *TT*, of ⅝ by 2½-inch wrought iron are placed under, the draft timbers at or near the drawbar stops, lipped up on the ends and fastened by ⅞-inch bolts; the front one has distance pieces under it to lower it sufficiently for the follower plates to work. The front ends of the draft timbers are tied together by the drawbar carrier-iron, *R R*, of 1 by 4-inch wrought iron, which also acts as a support for the drawbar, the draft-timbers being cut out on the bottom to receive it. The ends of this iron are bent up and fastened to the under side of the face block, or, when this is not used, to the endsill. Six ⅞-inch bolts hold this iron in place, four at the center and one in each end, all having lock nuts on the bottom. The two inside bolts come between the draft timbers and close to them, and over these bolt draft timber guards, *HH*, 5¾ inches high and preferably made of malleable iron, are fastened, each by two ¾-inch bolts; a B. standard size being 6 by 8¾ by 1¼ inches, and are made of wrought iron. When a spindle is used to connect them to the drawbar, they have a 2¼-inch hole through the center; with a yoke or pocket connection a hole is drilled in them, countersunk on the outside, to take a ⅞-inch rivet, which fastens a cast-iron thimble, *MM*, to hold the draft springs in place. The earlier drawbars and many in use to-day are connected to the follower plates by means of a spindle or tail pin, *NN*, as shown in Fig. 15. This pin is 2 inches in diameter, and its front end is provided with a head, either rectangular or cylindrical, with a flat space to prevent its turning; the rear end is either threaded for a nut or preferably has a slot in it to take a ½ by 2-inch wrought-iron or steel key, *UU*, which is prevented from working out of place by a ring or cotter pin.

It was soon found that this spindle connection was not as reliable as was desired, as the head became worn, allowing the drawbar to be pulled off the pin, or the latter would break, or the key would break or work out, allowing the drawbar to drop on the track, where it formed a dangerous obstruction and has been the cause of numerous wrecks. Another objection to the spindle connection is the large hole required in the follower plates.

These objections are overcome as shown in Fig. 16 by substituting a strap of wrought iron, *OO*, bent in the shape of a U and fastened to the top and bottom of the shank of the drawbar, forming a pocket, in which the follower plates and draft spring are placed. This pocket strap, or yoke, is made of 1 by 4-inch wrought iron with an opening 6¼ inches wide and as long as is required for spring and follower plates, ¼-inch being allowed for compression of the spring. The strap has hooks turned on the ends which lip over projections on the shank of the drawbar, and it is fastened to the latter by two 1¼-inch rivets, excepting on some constructions of draft gear in which the strap has to be taken off to remove the drawbar, in which case bolts are used instead of rivets.

The draft spring, *PP*, as recommended by the M. C. B. Association is 6¼ inches in diameter and 8 inches long, made of two coils of round steel, 1¼ and ¾ inches respectively, in diameter, the spring to have a total resistence, when fully compressed, of 22,000 pounds, and capable of being compressed 2¼ inches.

(To be continued.)



New Passenger Locomotive for the Great Western Railway of England.

rectangular opening 5¼ inches wide and 5¾ inches high is thus formed between the draft timbers in which the drawbar works. This opening has been adopted as standard by the M. C. B. Association, as has also the section of the drawbar at this point, viz., 5 by 5 inches.

The drawbar projects a certain distance beyond the end of the draft timbers, the standard adopted by the M. C. B. Association being 10½ inches to the center of contact between the couplers of two cars when there is no strain on them; this would leave only 21 inches between the two cars if the draft timbers were to end at the endsill, which would hardly be sufficient to allow a person to step between the cars, and it would be still less if the draft springs were compressed. When the endsills are on the outside of the sheathing, they are generally tapered down at the ends to increase the space between the cars, but to increase it considerably for at least part of the width of the car, face blocks, *II*, are fastened to the endsills above the draft timbers, and the draft gear is carried ahead a distance equal to the thickness of this block, thus increasing the distance between the bodies of the cars by double the amount. These face blocks also strengthen the endsill at its weakest point, and as they take all the wear due to the working of the drawbar, the cost of repairs is considerably reduced, as they can be renewed much more readily than the endsill.

This face block is made of oak, usually about 30 inches long and 6 by 9 inches in section, and is securely bolted to the endsill, two of the bolts often passing back and ending in plates which lip over the body bolster. On the front bottom edge of the face block a protecting plate, *S S*, is fastened, against which the horn *JJ* of the drawbar strikes when the latter is pushed in, forming a stop for it. This plate is made of ¾ or 1 inch by 4 inches wrought iron and sometimes of angle iron. The distance between its face and the horn of the drawbar is 1¾ inches when there is no strain on the bar, which is another standard of the M. C. B. Association.

The inside of the draft timbers between the drawbar stops is sometimes protected by a plate of ¼ by 6 inches wrought iron, *KK*, secured by countersunk wood screws, which prevents the follower plates from chafing the timbers.

The follower plates, *LL*, are two in number, the M. C.

Passenger Locomotive for the Great Western Railway.

In the accompanying engraving we illustrate the latest of fast passenger locomotives built by the Great Western Railway of England. Ten of these engines have been constructed at the company's shops at Swindon. They were designed by Mr. W. Dean, locomotive superintendent, and are intended for service on divisions where the grades are heavy and the curves both sharp and numerous.

The engines are somewhat American in appearance, with their four-wheeled leading trucks and extension fronts. The cylinders are 18 inches by 26 inches and are between the frames. The driving wheels are 67½ inches in diameter, which is considered rather small in English practice, but was decided upon in this case because of the heavy grades. The boiler is straight and is constructed of steel, with steel tubes. There is nothing unusual about it except the extension front already alluded to and the staying of the firebox crown. The front half of the crown is stayed by longitudinal bars, the front ends of which rest on the flange of the tube sheet, while the rear ends are suspended from the shell by heavy sling stays. The rear half of the crown sheet is stayed by short transverse bars of inverted ⊥ section, supported by sling stays to the shell. These transverse bars are only one-half the width of the box in length. This peculiar staying is employed to avoid rigidity. The boiler carries 160 pounds pressure.

The main driving axles have journals inside and outside of the wheels, but on the rear axles there are outside journals only. The driving springs are without any equalizing arrangement of any kind, and are peculiarly disposed in that while there is one spring over each rear journal there are two sets of main driver springs; one set is placed over the outside journals and the other set is under the inside boxes. The weight on the main wheels is considerably more than on the rear ones.

The principal dimensions of the engines are as follows:

Cylinders	18 inches by 26 inches.
Driving wheels	5 feet, 7½ "
Truck wheels	3 " 7½ "
Driving wheel base	8 " 6 "
Total wheel base	22 " 8 "
Diameter of boiler	52¼ inches O. D
Number of tubes	249
Size of tubes	1¾ inches O D by 11 feet 3¼ inches long.
Heating surface of tubes	1,285.6 square feet.
" " " firebox	112.6 " "
Total heating surface	1,398.2 " "
Grate area	19 " "
Boiler pressure	160 pounds.
Weight on main drivers	34,400 "
" " rear drivers	29,500 "
" " truck	39,200 "
Total weight in working order	103,100 "
Tender capacity	2,000 gallons.

We are indebted to *Engineering* for our illustration.

Water-Tube Boilers in the British Navy.

Evidently the English Admiralty retain their faith in the efficiency of water-tube boilers, as not only are a large number of new vessels being fitted with various designs of these boilers, but it has also been decided to reboiler No. 80 torpedo boat and the cruiser *Bellona* in each case with water-tube boilers. The *Bellona* is only four years old, and, although this vessel has done very little service, the boilers are reported to be considerably worn. The cruiser *Proserpine*, building at Sheerness, is also to be supplied with water-tube boilers. It is stated that the Thornycroft type will be adopted in this case.

According to *Engineering*, *H. M. S., Vindictive*, a second-class cruiser of 10,000 indicated horse-power, just laid down at Chatham Dockyard, is to be fitted with water-tube boilers of the Belleville type, 18 in number, by Messrs. Maudsley, Sons & Field, Limited, who are making the feed pumps, also of the Belleville type, and the air blowers or compressors for supplying air to each furnace to mix with the gases and aid combustion. The boilers are arranged in three groups, each group consisting of six boilers placed back to back, with the athwartship stokeholds. Each boiler is constructed for a working pressure of 300 pounds per square inch, and consists of eight elements, ten stories high, built of solid drawn steel tubes 4½ inches in diameter and seven feet, six inches long. The boxes connecting the tubes are of malleable cast iron. The total grate surface is 880 square feet, and the total heating surface is 25,000 square feet. There are six feed pumps, each capable of feeding six boilers and six air blowers; that is, one feed pump and one blown in each stokehold. The boiler installation is identical with those of the second-class cruisers *Gladiator*, *Furious* and *Arrogant*.

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

The action of the Supreme Court in issuing a writ of certiorari in the suit between the Westinghouse and Boyden air-brake companies is significant as being practically an admission of error in the decision of the Circuit Court of Appeals. This is the first patent case, not involving Federal interests or a question of jurisdiction, that has ever, under the method of procedure established by the statute of 1891, been ordered up for further action by the United States Supreme Court. Its decision will be awaited with interest and we trust that when rendered the decision will be so manifestly just to both companies as to be so considered by all parties.

It is popular in these days to decry the methods employed in departments of the government, and perhaps no one department receives more abuse than the patent office. Possibly it deserves some of it, but those who condemn the accumulation of a surplus in its treasury that in many years has risen to only $4,500,000 should be less hasty. During the last year or two great progress has been made in the classification of patents and in bringing the work up to date, so that there is less delay in the issuance of patents. We recently heard of a patent being allowed in about three weeks after application was made. It is hardly to be presumed that the work of reform is going to cease, and as reforms require money to carry them out, this surplus may actually decrease in the near future. Certainly it is better to urge reasonable reforms, even if they be extensive, than to advocate reduced fees as a means of wiping out the surplus.

In shops where the character of the output is such that manufacturing methods cannot be generally introduced throughout the entire plant, there are usually opportunities to employ these economical methods in the details. A shop that is building a certain line of engines on order, for instance, need not limit the number of small parts made at a given time to the orders then on hand for engines, but can make them up in fifties or hundreds, if too much capital is not tied up thereby. This method of working has been pretty well developed in some railroad repair shops to the profit of the company. To get the fullest benefit from such practices unimportant variation in the details of cars and locomotives must be avoided, and standards departed from only when absolutely necessary. This widens the field for manufacturing in the making of repair parts, makes the demand for any given part more regular, reduces the amount of stock to be carried and the capital tied up in finished parts. This is realized by many, but not every road gives it the attention it warrants, because of a mistaken impression that the number of pieces of any one part required by it are not sufficient to make such methods profitable, or to pay for the special tools by which the cost for labor is reduced.

After two years of trial, the Pittsburgh, Cincinnati, Chicago & St. Louis Railway has abandoned the "chain-gang" method of handling its motive power, and has returned to the practice of crews to each engine. Whether they are operated with single or double crews depends upon the amount of traffic and the demand for engines. Mr. Swanston, Master Mechanic at Indianapolis, finds by a comparison of accounts for different years that the "chain-gang" system resulted in an increased cost of roundhouse expenses of 11 per cent., that the engines had to be shopped more frequently, the passenger engines averaging about 20 per cent. less mileage between shoppings, and the freight engines 24 per cent. All this happened without any increased mileage per month as an offset. Exact information relative to the different methods of operating is and has been hard to get, and if any of our readers can contribute data of value on this subject we will be pleased to hear from them. One of the great difficulties to be overcome in the "chain-gang" system is the lack of interest in the engines on the part of the men. Mr. Swanston says that the individual crew system makes better machines of the engines, and better men of the crews. With the responsibility for the condition of the machine, he argues, comes a personal interest in it which must result in advancing their knowledge of the engine and making them more valuable men.

On another page we publish an account of interesting experiments made in France with a locomotive having a boiler whose firebox was lined with firebrick. From a theoretical standpoint a firebox devoid of heating surface should give more combustion and prove more economical than one having heat-conducting walls, providing the remainder of the boiler contains heating surface capable of reducing the temperature of the gases at the smokebox to the best practice of to-day. But those who consider the 160 square feet, more or less, of firebox heating surface as indispensable to good steaming qualities, it may appears to be impracticable to depend upon the tubes alone for heating surface. Nevertheless, it has been proved by several investigators working independently of each other that tube-heating surfaces can be relied upon to perform the additional duty demanded of them, without as great an increase in total heating surface as would at first be thought necessary. But while this is all true, our readers may be cautious in accepting the conclusion of the author of the article found in this issue that firebox heating surface can be satisfactorily replaced by an equal number of square feet of tube surface. That results supporting that view were obtained in the trials noted is probably attributable to the duty imposed on the boiler being much less than would be the case in this country. While the rate of combustion is not stated in the article, it is said the coal burned per mile was reduced from 80 pounds to 54½ pounds, and at ordinary speeds of freight trains that would involve the combustion of about 1,600 pounds per hour. As the tube heating surface in the new boiler, which approximately equaled the total heating surface of the old boiler, was 1,290 square feet, it follows that for each pound of coal burned per hour there was .81 square feet of heating surface. The common practice in this country is to load engines with all they can haul and the combustion per square foot of grate and per square foot of heating surface is almost always greater than in Europe. The average combustion here can be safely taken at one pound of coal for not more than .5 of a square foot of heating surface per hour, thus imposing a duty upon the heating surfaces of approximately 60 per cent. more than in the French experiment. Had the boiler been called upon to do the amount of work required in American practice all of the extra heating surface of the new boiler might have been required. While one of the avowed purposes of the test was to determine the durability of the firebrick walls, the author has not stated in his article what mileage was obtained from them.

A NEW ENGLISH LOCOMOTIVE.

On another page we reproduce from *Engineering* a perspective view of a new passenger locomotive, built for the Great Western Railway, by Mr. W. Dean, Locomotive Superintendent of that line. As this engine has some peculiarities, and as it differs very much from American practice in some respects and approaches it in others, a little criticism, comment and comparison with our way of doing things, may not be unprofitable to some of our readers on this side of the Atlantic, nor uninteresting to those on the other. What is proposed is simply to make such comments on these differences of practice, which strike an American, who has taken an active interest in locomotive construction and design, and to point out wherein the English and wherein the American practice seems to have advantages. It may be added that accompanying the view, which is reproduced on another page, *Engineering* gives a double page longitudinal section and sectional plan for which we had not room, but from which much of our information was derived.

As will be seen from the engraving, which is given elsewhere, the engine is of the bogie type with inside cylinders, and—what is very remarkable for an English engine—an extended smokebox. The wheel base, measured from the center of the truck to the center of the trailing wheels, is 19 feet. An American engine of similar size and weight would be made about 18 inches longer. This difference in length is a marked characteristic which differentiates English from American practice. Apparently the necessity of making the length of their locomotives, which have rigid wheel bases, very short has become a habit, so strong in the minds of our English brethren that it cannot be laid aside when then there is no longer any necessity for conforming thereto, or the length of existing structures, such as engine houses, turn-tables and sidings, on their roads, is too short for locomotives of a greater length than they have adopted. All American locomotive men would be unanimous that there is not the slightest need of making our locomotives shorter than they are in order to traverse any ordinary curves found on lines in this country or those on English roads.

The length of the tubes of "The Duke of Cornwall" are 11 feet 3¼ inches between tube plates, and 1⅝ inches in diameter. Longer tubes would have been practicable with a more extended wheel-base, and they then could have been increased in diameter and still retained their evaporative efficiency, with less liability to clogging up.

The inside cylinders and cranked axles are constructive features which would be universally condemned here. In this engine the driving-wheels are small, and as the steam chests and valves are placed below the cylinders, the latter had to be inclined 1 in 10. The opinion, or prejudice possibly, against the use of inclined cylinders on locomotives is so strong in this country that any engineer who would adopt them in the construction of a locomotive, unless it were under very exceptional circumstances, would be regarded here as a superannuated mechanical fossil. Now, it may be that this is an entirely unreasonable prejudice, but of its very general prevalence here there can be no doubt. In England, on the contrary, many, perhaps most, of the ablest locomotive superintendents still adhere to this method of construction. Who is nearest right? The arguments *pro* and *con* have often been stated. It is claimed for the inside cylinder engines that they run steadier, and that their cylinders are better protected from radiation, and also that the framing can be more compact and stronger than with outside cylinders. On the other side is the fact that cranked axles are first much more expensive and more liable to break than straight ones. To lessen this liability Mr. Dean has provided double bearings for the main driving axle, which are inside and outside the wheels. The trailing axle has only outside bearings. The crank cheeks are also reinforced with straps shrunk on them. The double bearings require duplicate frames, journal boxes and driving springs and supplementary outside cranks and pins for the coupling rods. Owing to the large diameter of the inside crank bearing the "big end" of the connecting rod must be about double the linear dimensions and its weight about four times that of a rod for an outside connected engine. On Mr. Dean's engine the forward part of the connecting rods are made with forked ends and double strap bearings—but this is not essential. It is nevertheless expensive, although it makes a good job when finished.

Another objectionable feature is that the firebox must be about a foot shorter with cranked axles—to give clearance for the cranks—than it need be with outside cylinders. This may not be a serious objection where good coal is used, but with poor fuel the additional length of firebox is important.

Doubtless better drainage of the cylinders is secured, by placing the steam-chests below them, and inverting the slide-valves than there would be if they were placed on top, but in the engine which is now being discussed the steam chests are immediately above the center bolster of the truck, which has an arrangement that permits of its transverse movement in relation to the engine. It is not easy to see how the valve-seats can be faced without removing the truck, and then the workman must operate on an inverted surface like the ceiling of a room. It is to be feared that such an arrangement would cause a good deal of profanity in American roundhouses if that method of construction was generally adopted here. It would be interesting to have an estimate of the cost of a set of cylinders, connecting-rods, crank-axles with duplicate boxes, springs and frames and outside cranks, and then compare it with the cost of the same parts as ordinarily made for outside cylinder engines. What American locomotive engineers would be interested in knowing is the compensating advantage for this difference in cost.

It is of course true that by placing the cylinders between the wheels, and inclining them, and then putting the valves below them, that the links can be connected directly to the valve-stems on a horizontal line drawn through the center of the driving-axle. European designers of locomotives appear to have abhorrence of rocking-shafts and they will resort to all kinds of expedients to avoid their use. Now, as a matter of fact, there is hardly anything about an American locomotive which costs so little to maintain as the rocking-shafts which are used here with link-motion valve-gears, and probably nine master mechanics out of ten in this country would much rather maintain and lubricate such "rockers" than keep up the sliding guides for the valve-stems, which are directly connected to the links as they are shown in the illustration before us. The bearings of a rocker are cylindrical and are enclosed and are never exposed to dust. A reciprocating guide, on the contrary, has a considerable part of its frictional surface exposed during each stroke and is thus more difficult to keep oiled and more subject to wear. Besides the bearings of the rocker are more accessible, which is an important feature, which leads to the observation that English designers seem to take great pains to hide all appearance of complication, and to do this, are given to putting everything that it is possible to hide inside, where it will be out of sight, or, in the language of St. Paul, they "look on things after the outward appearance." American designers, on the contrary, try as far as possible to put all working parts outside, where they will be accessible.

The boiler of Mr. Dean's engine is made of steel, with steel tubes, the staying of the crownsheet being quite peculiar. The rear half of its surface is provided with transverse crown stays, the general form of which is that of an inverted letter ⊥, the vertical and horizontal parts of which are united by a pin connection. The lower portions of each of these ⊥'s extends from the outer edge of the crownsheet to the middle and is connected to it by crown-bolts. The upper edge of the ⊥ is attached to the outside shell. The front half of the crownsheet, on the other hand, is supported by longitudinal crownbars, which are only half the length of the crownsheet and each of which has its front end resting on the tube plate, while its rear end is hung from the outside shell or "casing" of the firebox by a pivotal pin and sling stay. Between the two ends the bars are connected to the crownsheet by bolts. "This system," *Engineering* says, "has evidently been adopted with a view of avoiding too great rigidity, and allowing for expansion." With this arrangement the front ends of the crown bars are free to move up or down with the expansion of the tube plate and of the firebox. The back ends are, however, supported by the sling stays, while the part of the sheet between the ends of the bars is supported by the bolts. A somewhat similar action may take place with the transverse ⊥ stays, the horizontal part of which may rock on its pin connection with the vertical part in case the side sheets are expanded. This method of staying seems to have merits which are well worthy of consideration.

A feature which is worthy of consideration by American engineers is the construction of the driving-springs. These are 3 feet 6 inches long, measured from center to center of hangers, and consist of four plates of 4 by ⅝-inch and four plates of 4 by ½-inch steel. The hangers of both the driving and truck springs are supported by cylindrical rubber pads 5¼ and 4¾ inches diameter and 3 inches thick. These are held in cast-iron cages or boxes, the link hanger being a round rod with a nut and a washer below the rubber, the springs being connected to the upper ends of these hangers by links which permit the free movement of the springs. This is a much better arrangement than is ordinarily provided in American engines, although the absence of equalizing levers between the driving axles would hardly be approved in this country, but with a good road-bed and the excellent arrangement of springs provided by Mr. Dean, it is an open question whether equalizers are essential or important.

The driving tires have safety flanges which lock into grooves in the wheels on the outside, and have retaining rings on the inside, a practice which it would be well for us to imitate more than we do.

The tender and engine truck wheels are of the Mansel wooden disc pattern, 43¼ inches in diameter. This form of wheel is very extensively used in England, but has never met with favor here. Some years ago they were tried on the Erie road and, we believe, some other lines, but failed. Why is it, it may again be asked, that these wheels are so satisfactory in England but fail here?

From our engraving it will be noticed that the truck axles have outside bearings. This would be impracticable if the cylinders were outside, and as outside bearings certainly have advantages over those inside, this feature may be counted in favor of the inside cylinders. The truck center-pin has a semi-lateral movement which is controlled by spiral springs, and the center-pin has a spherical bearing which permits perfectly free adjustment to lateral or longitudinal inequalities of the road, which cannot be said of our engines, which rest on broad, flat bearings on the trucks.

The exhaust pipe extends from the steam chests—which it will be remembered are below the cylinders—upward between them to a point level with the top row of tubes. This pipe has a division in it which extends from the steam chests to the top of the fifth row of tubes, counted from the bottom, and has a single large nozzle at the top. This arrangement thus seems to have the advantages of both the single and the double nozzles. The chimney projects downward inside the smokebox to a point about half way from its top to the upper row of flues, and has a flaring mouth at its lower end.

Another noteworthy feature is the fact that the engine has two pumps, which are worked from the crossheads, and apparently no injector. It would be interesting to know what led to this reversion to pumps on this line.

The sand-boxes, it will be seen, are placed over the frames, which makes them more accessible and removes them from a position where they obstruct the view and are certainly not ornaments.

A feature of this engine to which the attention of our locomotive superintendents and builders is especially directed is the steps which are provided on the engine and tender. There are, in the first place, two sets of steps, one on the engine and the other on the tender, which are alike and are on the same level. The lower ones are of liberal length and width, and have high flanges on the ends to prevent a person's foot from slipping off. In getting on or off the engine one foot can be securely placed on one step and there is then a place for the other immediately alongside of it. On many American engines the steps are of such a form and size that it is not easy to find them nor to secure a foothold, and they are often not arranged in pairs, so that when the right foot is in place the position for the left one is not obvious. Between the engine and tender the steps are arranged in pairs horizontally and also vertically, or one above the other and with a plate back of them to prevent those mounting the engine from thrusting their feet inward. It should be noticed, too, that the same kind of steps are provided at the back end of the tender, and also between the main driving and truck wheels. These are all alike and on the same level, and for that reason anyone is less likely to make a misstep than they would be when the form, position and size of the different steps are unlike. In this respect this English practice is better, more intelligent and more humane than ours. The number of men who are killed and injured annually from falling off engines and cars is very large. Certainly it is the duty of all who have control of such matters to diminish the risks. Old Ross Winans was in the habit of advising his apprentices in this wise: "Boys," he would say, "if you must make a thing strong, make it d——n strong." It is not needful, perhaps, to imitate the old gentleman's forceful language, but it may be said that if you can make anything safe, then make it as safe as you can. The length and width and depth and location of these English steps certainly gives the men who must use them more security than they can have when what are called "pads" are used, to which Mr. Winans' adjective might properly be applied.

THE REVISED RULES OF INTERCHANGE.

The report of the committee of twenty-one appointed by the Master Car Builders' Association to revise and rearrange the rules of interchange on the lines suggested last year by the Southern and Southwestern Railway Club, has been issued and discussed by several of the railroad clubs. The report recommends a rearrangement of the rules under several headings such as "instructions to inspectors," "instructions to repair men," "instructions for billing" and "miscellaneous." The wording of the old rules has been retained in nearly every case but a few clauses have been introduced to make them conform to the spirit of the new interchange at Chicago, and an attempt has been made, but imperfectly carried out, to indicate responsibility for defects by statements after each section of the rules defining the defects for which cars may be refused.

The result of all this rearrangement is that while the code has gained somewhat in clearness it has lost none of its bulk, and yet such club discussions as we have read have been devoted almost wholly to the correction of sections that were not quite clear in the revision; in fact, nearly every one seems to have fallen in line and advocated the revision without at the same time insisting on condensation. This condition of affairs is much to be regretted, for now is the time to insist on greater simplicity. Delays to freight will not be reduced by simply reversing the phraseology of the rules so that instead of reading that "cars may be refused" for certain defects, they will read that "cars must be accepted" unless certain defects exist; what is wanted, rather, is as simple a code as can be devised on the principle of owner's responsibility. The words of Mr. John McKenzie before the New York Railroad Club should be carefully read by every official that has a vote in the Master Car Builders' Association. He said:

"It seems to me that the code of rules proposed by the Committee of Twenty-one goes as far as possible in the line of getting us deeper into a rut that we have been traveling in for the last ten years, by conglomerating and mixing up a lot of rules that do not assist the object that we have before us—that is, the smooth and equitable interchange of cars. The time has gone past when we can get together and say that you may receive a car, if you want to, and every place where the word 'may' is introduced in this code of rules, the word 'shall' ought to be introduced. Cars can be moved and they can earn money instead of waiting for somebody to make up his mind as to whether they shall put an I O U on the car or not; and it lies with us whether we shall change the rules, and make them so simple and so positive in their operation, that the cars must move, rather than have them stand on the side tracks until a few men who are able to earn a dollar and a half a day shall wrangle and decide whether the car shall move or not. The transportation departments of this country have come to the conclusion that a smooth interchange can be introduced. The Chicago agreement has shown that it can be done. The mileage of the cars has been increased a very large percentage, and the time has come when we must either do something or they will take it out of our hands and let somebody else do it. The transportation departments are ready to-day to take hold and make an interchange that will move the cars of the country.

"There is no question in my mind that all this business of going through the multiplication table, adding to and taking from, going from 1 to 84, and then going through the alphabet six or seven times from a to z, illustrating all these rules and the interpretation thereof—all this has gone by. We must stop it. What we want to say is that cars shall be offered in a serviceable condition, and they shall be accepted. Make the owners responsible for the defects that follow under fair usage. Under the Chicago agreement we undertake, with about 13 different paragraphs, to cover the entire code of rules, and everything is working smoothly."

A fact which has an important bearing upon this whole business of revision is that the entire Pennsylvania system has gone into the Chicago agreement. This is another way of saying that at the June convention the new interchange will receive the votes of that system and that unless others who supported it last year change their votes it will be adopted this year. With this in prospect there should be a greater condensation of the rules than has thus far been proposed.

The present revision says (section 43) that "owners are responsible for failure under fair usage of any part of the body of the car," and (section 40) that "all defective or missing or worn out parts not already mentioned, which have failed under fair usage (are) chargeable to owners." Now if this is the case why should all of the sections relating to brake gear be retained? If a brake wheel is defective the owner can be billed for a new one without it being specifically mentioned in the rules. It would seem as if most of sections 18 to 39 could be omitted. The elaborately defined and illustrated defects of couplers can also, in the opinion of many practical men, be omitted. It ought to be possible to omit section 52, which says that "locks, grain doors and inside parts of cars are at owners risk, except where damaged by wreck or unfair usage," if section 43, above quoted, means what it says.

There are also some things in the rules the absurdity of which is not appreciated because of long familiarity with them. For instance we are told that cars can be refused if the axles are bent or broken or the collars worn off! Or if a wheel under the car is burst or is loose on the axle! Such rules ought not to be required in this generation, and if they are needed it is a severe comment upon the manner in which interchange is now handled, and is to be handled under the new agreement.

From the discussions on interchange rules one would think that nearly the entire cost of car repairs was involved, but as an actual fact the percentage is quite small. One of the largest systems in the country can show by its accounts that the repairs to its own cars made by foreign roads amounts to but 1.5 per cent. of the total cost of the repairs to its cars and of several other large roads whose figures we have seen none show more than 3 per cent. Though this small per cent. runs into the tens of thousands of dollars any lack of equity in the items composing it are so largely offset by similar bills against other roads, that probably the most ardent advocate of rigid rules cannot show that the least equitable of the rules ever put in force by the association added one-half of one per cent. to the total cost of car repairs through work done on defect cards or in interchange, except as they have compelled the making of unnecessary repairs by the owing road. With such a small percentage of the total cost of car repairs involved in the repairs which foreign roads are empowered to make on the cars of any road, and with a saving in prospect from the reduction in the amount of unnecessary repairs and the avoidance of delays in interchange, it behooves the members of the Master Car Builders' Association to so frame the new rules as to get the full benefit of the change, and to show by such action that are really actuated by that broader spirit of which the adoption of the Chicago interchange is supposed to be indicative.

"Industry."

Those persons whose good fortune it has been to have had the acquaintance with and knowledge of a monthly magazine published in San Francisco and edited by John Richards will regret to hear that its publication will probably be discontinued after January, 1896. In that number the following announcement was published:

"The present publishers of *Industry* will not issue the magazine longer. If a new management assumes the business, proper announcement will be made to its patrons and clients. Five thousand pages of matter, nearly all originally written, have been furnished to our readers in good faith, in candor, and continuous effort toward honesty and truth, but the work is, and has been for several years past, more than their powers permitted, or the patronage of the journal warranted.

"During eight years of publication there has been a great change in the conditions under which a technical journal must be conducted on this coast in order to secure the commercial patronage required to sustain it. The methods are neither congenial to nor consistent with an independent technical publication devoted to matter such as has appeared in *Industry*, nor with the policy first assumed and continually carried out, that of laying before readers useful truths that would promote their interests and business.

"The present issue has been delayed by the illness and absence of the editor. It closes his and the publisher's labors, and it remains to thank many warm friends who have encouraged and promoted *Industry*."

There is a pathetic tone about this, which will perhaps express the feelings of other editors as well as those of the author of what is in reality a valedictory, or the antonym of an announcement. *Industry* has been one of the most delightful publications that reached our pile of exchanges. It came each month with the fresh characteristics which were infused into it by the original work of its editor. Unlike most other publications, its contents consisted largely of matter written by him, who each month gave his readers the most interesting and instructive comments on current engineering subjects. Research need not be carried very far among his contemporaries to find others to whom the methods and conditions which must now be adopted or complied with "to secure commercial patronage are not congenial" nor appear to be consistent with independent technical journalism. Whether it was this reason or that of ill-health—vaguely hinted at—which has led the author of the charming articles in *Industry* to abandon the editorial field, it will in either event be much regretted by those who know him or his publications, and still more by those who know them both.

The South-west Railway Record and Engineering News

We are in receipt of a copy of No. 6 of this—to us—new publication, issued in Kansas City, with a request to exchange which will be cheerfully acceded to. The paper is neatly printed, and has a sort of an enterprising and "hustling" tone about it which is indicative of its Western habitat. As will be seen, it has adopted as its sub-title that of one of our New York contemporaries. This appropriation is, however, regarded in this office with equanimity, for the reason that the journal which has thus been despoiled of its good (?) name was guilty of a similar act some years ago in adopting "*Railway Journal*" as its sub-title, which is substantially the name under which this paper had been published for over 50 years, and which is still retained. The court refused to right the wrong, and our friends in Kansas City can now appeal to its decision, if they are disturbed in the possession of that which our sense of integrity compels us to admit is not fairly theirs, any more than *Engineering News* of New York is entitled to use *Railway Journal* as part of its title.

Notes

Many of the cases submitted to the Arbitration Committee of the M. C. B. Association for settlement are so simple that it is a matter of surprise that they were ever presented to that body, but in the latest report of the committee there is a case of considerable importance. It is Number 323 and is between the C., C., C. & St. L. and the Terre Haute & Indianapolis railways. In July, 1895, an elevator located on a siding connecting with the T. H. & I. Ry., was destroyed by fire, and several cars burned, among them two C., C., C. & St. L. cars. The latter road has a contract with the T. H. & I. Ry., by which its cars are delivered on this siding to be loaded and re-delivered to the C., C., C. & St. L. Ry., for a switching charge of $1.50 per car paid to the T. H. & I. Ry. In the case of the two cars burned, it happened that the C., C., C. & St. L. train crew with their own engine switched the cars over the other company's tracks and onto the siding, because there was no T. H. & I. crew on hand at the time to do the work. The switching charge was paid, of course, just the same as though the switching had been done by the other road. The T. H. & I. Ry. claimed that it did not deliver the cars onto the siding as per rule 28, while the C., C., C. & St. L. Ry. claims that in doing the switching it was only acting for the other road, and that the road owning the tracks connecting to the siding is and is the only party that can be expected to have a contract with parties owning the siding covering loss by fire. The Arbitration Committee decided in favor of the C., C., C. & St. L. Ry., saying: "If the owners of the track had actually made the delivery there would not, under the rules, have been any room for dispute, nor is it believed that the fact of another road having attended to the work for the track owner and having paid them for it alters the case."

A compound engine of 10 horse power and weighing, with its pumps, 185 pounds, was recently exhibited in England. It was built for a launch and makes 600 revolutions per minute with a steam pressure of 250 pounds.

At the Lake Shore shops at Englewood, Chicago, Mr. T. Fildes bends air-brake train pipes on the bulldozer. The pipes are first cut to proper lengths and then bent by the use of suitable dies. After a large number of pipes are bent and stacked up, a man turns a steam jet into each pipe, thus removing any scale or dirt that may be in them.

The *Railway World* is authority for the statement that on the London & South Western Railway the oil lanterns carried by ticket collectors and by the light of which they were enabled to decipher passengers' tickets, have been superseded by small electric lamps, which are fixed on the overcoats of the collectors and supplied with current by a small accumulator carried in the breast pocket. A month's experiment is to determine whether the innovation is an improvement, and if the officials find it such, the electric lamps will be generally adopted. It is said that on several omnibus lines similar apparatus have proved a convenience greatly appreciated by conductors.

A $200,000 steel steam yacht for Mr. P. A. B. Widener, of Philadelphia, is under construction at the Crescent shipyard, Elizabethport, N. J. It is 225 feet long, 183 feet long on the water line, 28 feet beam, and draws 11 feet 6 inches of water. The displacement is 800 tons. There is a steel house on deck 135 feet long and 18 feet wide, over which is a promenade deck. The engines are to be triple expansion, with cylinders 18, 27 and 42 inches in diameter and 28 inches stroke. Two Scotch boilers will furnish steam at 175 pounds pressure, and it is expected that 1,250 horse power will be developed. The capacity of the coal bunkers is 210 tons. An electric lighting plant and a refrigerating plant will be installed. The furnishings will be costly, and when completed the owner intends taking his family in it for a trip around the world.

The use of liquid fuel has been so extended on the Great Eastern Railway (England) that a large storage plant has been erected at Stratford. Twenty-five locomotives are now fitted with oil burners under the Holden system, and 12 stationary boilers and three furnaces at the shops burn the same kind of fuel. The oil arrives at Stratford in bulk, old locomotive tenders being employed in transporting it at present. The storage tanks are 13 in number and are placed on low ground not very far from the main line. The oil flows to them by gravity. A peculiarity of the tanks is their rectangular shape. Nine of them hold 3,600 gallons each and the remaining four 2,500 gallons each, making a total of 37,000 gallons storage. From these tanks oil is pumped to an elevated tank of 4,000 gallons capacity (also rectangular) from which it is taken for consumption. Locomotives burning 35.4 pounds of coal per mile perform equal duty upon 16.5 pounds of oil per mile, and if the fuels are mixed the engines will average 11.8 pounds of coal and 10.5 pounds of oil per mile.

A committee of the Association of American Steel Manufacturers has asked the Board of Supervising Inspectors of Steam Vessels at Washington to amend the present specifications for steel boiler plate by striking out Section 13 relating to test pieces, and putting in their place four paragraphs which specify that steel for marine boiler plates must be made by the open-hearth process, and be of domestic manufacture; that the test pieces used to ascertain its strength shall be 1 inch wide at the reduced section, and 9 inches long with 2-inch radii connecting the reduced section with the ends, and that said ends shall be 1½ to 2 inches wide and from 4 to 6 inches long; that before placing the test piece in the machine punch marks shall be placed at intervals of 1 inch, and the length in which the elongation is measured shall be taken as nearly equally as possible on both sides of the fracture; in plates less than ½ inch in thickness this length shall be 2 inches; in plates ½ inch thick and up to ⅞ inch it shall be 4 inches; in plates from ⅞ inch to 1 inch inclusive it shall be 8 inches, and in plates over 1 inch it shall be 6 inches. It is also suggested that the maximum figure which can be stamped upon the steel as indicating its tensile strength shall be 60,000 pounds per square inch, and the factor of safety in all cases shall be five. The committee also recommend that the board place a limit upon the amount of phosphorus and sulphur allowable in plates, as under the present rules of the Board it is possible for a manufacturer to use a metal for boilers which would not be accepted by the majority of engineers for the most unimportant work, and it is considered certain that such a clause would be a long step in the direction of a much better and safer metal, while it would not materially enhance the cost. As to the limit of 60,000 pounds for tensile strength, the committee say that under the present law there is nothing to prevent a boiler maker from ordering steel with a tensile strength of 70,000 pounds, or even 80 000 pounds, per square inch, and using a proportionately high steam pressure. This material is considered dangerous by the manufacturers. In asking that the factor of safety be made five, it is claimed that while the factor is now nominally six, it is based upon the strength as exhibited by a grooved test piece, which always gives results higher than the actual strength, and by making the factor five and basing it upon the strength as derived from a parallel-sided test piece the actual factor of safety is the same as in the past.

A test of steam pipe coverings was recently conducted under the auspices of the Boston Manufacturers' Mutual Fire Insurance Company, by C. L. Norton, the results of which are given in the following table, in which the losses are expressed in ratios, that from a bare pipe under 200 pounds pressure being given as unity:

200 pounds steam pressure.	Loss.	10 pounds steam pressure.	Loss.
Nonpareil cork	0.254	Nonpareil cork	0.232
Magnesia	0.281	Air cell 2	0.261
Air cell 2	0.284	Magnesia	0.262
Air cell 1	0.301	Magnabestos	0.383
Magnabestos	0.321	Fire felt	0.395
Fire felt	0.333		
Calcite	0.423		
Bare pipe	1.000		

The method of making the test was novel. A piece of double thick steam pipe four inches in diameter was filled with oil and a suitable stirring apparatus inserted through the upper end, the pipe occupying an upright position. A coil of wire was also immersed in the oil and connected to an outside circuit. A thermometer, voltmeter and ammeter completed the apparatus. By turning on an electric current until the heating coil raised the oil to the required temperature and then regulating the current until the temperature was maintained exactly, the heat furnished by the current was evidently equal to that lost by the pipe, and could be calculated from the current readings. The materials tested were applied to the outside of the cylindrical part of the pipe, the ends being protected by the same blocks of calcite, four inches thick, throughout all the tests. The thicknesses of the protecting materials are not given.

The Brooklyn & New York Ferry Company, which operates the Grand Street Ferry, has contracted with John B. Roach for two more ferryboats similar to the three recently built for them at the same yards. The new boats will be built of iron instead of steel, the latter material being considered better calculated to resist the action of the acids and other corrosive materials poured into the East River from the sewers of New York and Brooklyn. They will be double-deckers, 168 feet long, 36 feet 6 inches moulded beam, 62 feet over the guards and 14 feet 6 inches depth amidships. They will be driven by condensing engines and have single boilers 10 feet 6 inches in diameter and 28 feet long. The wheels will be 19 feet 6 inches in diameter. The boats will be supplied with gas and electric light plants and steam steering apparatus, and will be handsomely finished throughout.

Figures compiled by the Glasgow *Herald* show that there has been a steady decrease since in 1891 in the number of men employed in the locomotive building industry of Great Britain. In 1891 the number of men engaged in this line of work was 11,803; in 1892, 9,971; in 1893, 9,043; in 1894, 8,251, and in 1895, 8,473. Part of this falling off is accounted for by the smaller export business, other countries doing more of the building for themselves.

Underfeed stoking, which means that the fuel is fed upward beneath the fire, instead of placed on top, is an extremely common-sense method if considered in the abstract. In the concrete it involves apparatus that is not a desirable adjunct to a steam furnace, also involves artificial or forced draught, but even on those conditions there is strong probability of survival of the system.

There is a conflict of conditions or principles in this matter of heating furnaces that it will be hard to reconcile. If the draught is upward, and the fresh fuel fed on top, the combustion is wrong-end foremost and smoke unavoidable. If downward, the fuel sustaining part, the grates, are burned out; horizontally a draught through a deep stratum of the fuel is impossible.

The subject has come with increasing interest during ten years past, and while there has been no distinct invention or method that can be called satisfactory, it is a good deal to have gained the admission that improvement must be made.

Some years ago, when in Portland, Ore., we came across a steam furnace burning wood for fuel, the supply being forced through a tube under the grates. The impression at the time was, that here was a scheme that might possibly find wide extension in future, and the subject is again brought to mind by a circular received from the Jagoda Furnace Company, of Portland, Ore., relating to underfeeding furnaces, with tabulated results from various places where their system has been applied.

As now arranged a steam piston is employed to push in at intervals a charge of fresh coal beneath the fire, air being supplied by means of fans.

The Edison Electric Light and Power Company, of this city (San Francisco), have equipped their new boilers with this apparatus for underfiring; so also the Omnibus Cable Railway, and as these large plants are under the care of able and conservative engineers, there is no doubt of the practical working and economy of the system.

It is a fertile field for invention, this fuel burning, and it seems strange to see a struggle after a few per cent. of increased efficiency in steam engines when ten times as much can be, and is, lost or saved by methods of firing.—*Industries.*

Trade Catalogues.

[In 1891 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car-Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

STANDARDS.

For postal-card circulars	3½ inches by 6¼ inches.
Pamphlets and trade catalogues	3½ inches by 6 inches. 6 inches by 9 inches. 9 inches by 12 inches.
Specifications and letter-paper	8½ inches by 10¾ inches.

CATALOGUE OF LOCOMOTIVES. COOKE LOCOMOTIVE AND MACHINE COMPANY. Paterson, New Jersey: 1895. 71 pages, 6 by 9 inches. (Standard size.)

This old established company, in conformity with the practice of other establishments, has issued a "catalogue" which is a good deal more than its name implies. It is in fact to some extent a history of its founder, and of the company of which he was the head, and the works which he originated, and it then describes the products of that establishment.

The frontispiece is a portrait showing the genial and kindly face, which some of us older numbers can recall with so much pleasure. It gives a brief biography of him, and states a fact which is probably not generally known, which is, that he was a native of Montreal.

Views of the works in 1852, 1882 and 1895 are given with a historical sketch of their origin and development. The present establishment and its facilities for doing work are then described, with views of the office, the inside of the machine shop, the erecting and boiler departments and the hydraulic flanging press, with samples of the work done on it. A view of the inside of the foundry and the transfer table with a rotary snow-plow—manufactured by this company—on it, are also shown. A view is also given of a 40-foot water-wheel, which is also one of the products of these shops. This is followed by a general description or blank specification of a locomotive.

The second part of the book has the title "General Description of Some of the Locomotives Built by the Cooke Locomotive and Machine Company," and gives a series of views—half tone engravings—of eleven different kinds of eight wheeled or American type of engines, eleven ten-wheelers, seven "Moguls," five "Consolidations," four diagrammatic views of the latter class, four half tone engravings of six-wheeled switching engines and six diagrammatic views of four-wheeled "switchers." The book ends with tables giving the dimensions of the different engines built by the company. The catalogue is printed on heavy paper, and on one side of each leaf only, so that it is larger than the number of pages would indicate.

We are inclined to question the propriety of this. In these days of multiplicity of literature, economy of space should be aimed at. It would be a distinct advantage if this—and other catalogues—occupied only half as much space as they now do on our bookshelves, and the mere bulk of a book is often a reason why it is not preserved. The printing, paper and binding are all admirable, but some of the illustrations are hardly up to the highest standards of excellence of to-day. If catalogue makers would only know how much a coat of dull, lead colored paint, on the objects photographed, would improve their pictures, they would have much better illustrations than they now have. If, for example, the hydraulic flanges illustrated in the book before us had been painted in that way before being photographed, the pictures of it would have been immensely improved. It may also be suggested that the attendants, shown in their positions, ought also to have had a coat of some kind of paint before their portraits were taken, so that they would look a little less like New Jersey politicians than they now do. The catalogue is in excellent taste, and serves its purpose of making known the kind and character of work done in this establishment. A supplementary notice pasted in it announces that Messrs. Bryan & McKibbin, of 120 Broadway, New York, have become the general sales agents of the company.

CHAIN BLOCKS. *The Yale & Towne Manufacturing Company.* 44 pages, 6½ by 8 inches. (Not standard size.)

CASE'S IMPROVED PROPELLER WHEELS. A. Wells Case, Highland Park, Conn.: 41 pages, 5¾ by 7½ inches. (Not standard size.)

BEAMAN & SMITH, Providence, R. I., designers and makers of machinery and tools. Catalogue D. 64 pages, 3¾ by 5¾ inches. (Not standard size.)

The class of tools illustrated in this catalogue and which is manufactured by this firm includes chiefly milling, drilling and boring machines, with a few lathes of standard type. Some 25 different patterns of tools are illustrated and described. They are represented by very good wood engravings, printed on a light green ground. The latter feature does not seem to be a happy invention, although the character of the machines is clearly shown and the descriptions are full and satisfactory.

SOMETHING ABOUT WESTINGHOUSE ENGINES. 12 pages, 3¾ by 5¾ inches. (Not standard size.)

The purpose of this little pamphlet is to describe the thoroughness with which this company tests its finished engines before they are sent away from the shop. To this end views are given of their engine testing room, and another of the surface condenser, and weighing tanks employed. The methods of testing are described, and the objects arrived at are set forth.

TOBIN BRONZE. The Ansonia Brass and Copper Company, Manufacturers, New York. 36 pages, 3¾ by 5½ inches. (Not standard size.)

DIAMOND GRINDING MACHINERY FOR ALL METALS, CATALOGUE NO. 15. Diamond Machine Company, Providence, R. I. 64 pages, 5¾ by 9 inches. (Not quite standard size.)

From this catalogue the reader can get some idea of the variety of purposes for which emery wheels are used, which are indicated by the number of different kinds of grinding machines which this company makes. Over 50 different machines are here illustrated by good wood engravings with brief descriptions and statements of the uses for which the machines are intended. Any mechanic will be sure to get some new idea of methods of doing work, by looking through this book and becoming acquainted with the special machines which are made for special work.

The publishers evidently intended it to be of standard size, 6 by 9 inches, but the binder trimmed it to 5¾ inches. We have often wondered that cases of homicide of bookbinders is not more common. With the most careful instruction about trimming books, they will often spoil them by cutting away the margin, apparently out of pure cussedness.

WIRE ROPE TRANSMISSION IN ALL ITS BRANCHES. The Trenton Iron Company, Trenton, N. J. Cooper, Hewett & Co. New York. 68 pages, 5¼ by 8 inches. (Not standard size.)

This is what may be called a trade treatise, but as it bears the imprint of 1892, is apparently an old publication with new covers, and therefore hardly demands extended notice. The title page says it relates to Wire Rope Tramways, with special reference to the "Bleichert" and "Acme" Patent Systems; also, Single-Rope Tramways, Patent Cableways, for Quarries, Open Cut Work, Ferries, etc. Wire Rope Outfits for Shafts, Inclined Planes, Underground Haulage Plants, etc., and Power Transmissions. It is illustrated with many engravings showing views and details of wire rope "plants." Some of these illustrations are excellent, but others cannot be highly commended. Altogether, though, it is an admirable publication and is an indication that in the future every trade catalogue will be an elementary treatise on the art to which it relates.

Personal.

Mr. E. M. Dickey has resigned as President of the Hot Springs railroad.

E. S. Jemison, President of the Houston, East & West Texas, died last month.

Mr. H. M. Comer has been elected President of the Central Railroad of Georgia.

Mr. William Davis, President of the San Antonio & Gulf Shore Railway has resigned.

Mr. Dwight M. Philbin, General Manager of the Duluth, Missabe & Northern Road, has resigned.

Mr. M. V. Meredith has been appointed General Manager of the South Haven & Eastern Railway.

Mr. W. H. Young has been appointed Master Mechanic of the Southern Railway at Sanford, Fla.

Mr. Stanley E. Russell, representative of the Q. & C. Company at Atlantic, Ga., died on Feb. 13.

Mr. T. R. Foster has accepted the position of Mechanical Engineer on the Denver & Rio Grande, at Denver, Colo.

Mr. Geo. Thompson has been appointed Master Mechanic of the Beach Creek road, vice Mr. La Mott Ames, resigned.

Col. W. P. Thompson, President of the Ohio River Railroad, died suddenly of pneumonia in New York City, on Feb. 8.

Mr. T. C. Sherwood has been appointed General Manager of the Kansas City, Pittsburgh & Gulf Railway with office at Kansas City.

Mr. F. G. Wheeler has been appointed Purchasing Agent of the Oregon Railway and Navigation Company, with office at Portland, Ore.

Mr. W. J. McLean has been appointed Master Mechanic of the Third Division of the Plant System, with headquarters at Montgomery, Ala.

Mr. Albert G. Blair, who has been General Manager of the Wheeling & Lake Erie since 1892, has been chosen President, to succeed Mr. F. R. Lawrence.

Mr. John H. Winder, General Manager of the Seaboard Air Line, has retired from that office, and its duties will be combined with those of the vice-presidency.

Mr. A. D Ward has been appointed Purchasing Agent of the Chicago Great Western, with headquarters at St. Paul, Minn., in place of Mr. John Warwick, resigned.

Mr. J. Forster, Assistant Master Mechanic of the Atchison Topeka & Santa Fe at Argentine, Kan., has been appointed Master Mechanic of that road at La Junta, Colo.

Mr. C. H. Hudson, Chief Engineer of the Southern Railway, has also been appointed Mechanical Engineer of that road, with advisory duties in the motive power department.

Mr. James McCrea, First Vice-President of the Pennsylvania lines west of Pittsburgh, has also been chosen president of the Terra Haute & Indianapolis, to succeed Mr. W. R. McKeen.

Mr. Edwin C. Hiser, Master Mechanic of the New York Central & Hudson River, the Rome, Watertown & Ogdensburg, and the Adirondack & St. Lawrence, with office at Utica, has resigned.

On account of bad health, Mr. J. D. Campbell has resigned the position of Master Mechanic of the Buffalo & Susquehanna Railroad to take effect upon the appointment of his successor.

Mr. C. M. Lawler has resigned the position of General Manager of the Philadelphia, Reading & New England Railroad, and Mr. W. J. Martin, formerly General Freight and Passenger Agent, succeeds him.

Norman J. Paradise, General Master Mechanic of the Hannibal & St. Joseph, and St. Louis, Keokuk & Northwestern, died at his home in Hannibal, Mo., in January. He had been with the Burlington system since 1859.

Mr. J. B. Swann, General Foreman of car repairs of the Pittsburgh division of the Pennsylvania lines at Dennison, O., has been transferred to Columbus, O., as General Foreman of Car Repairs, to succeed Mr. John Commerford, resigned.

Mr. John H. Orchard has been appointed Master Car Builder of the Pennsylvania Division of the Delaware & Hudson Canal Company, and of the Gravity Railroad with headquarters at Carbondale, vice Mr. Thomas Orchard, deceased.

Mr. E. M. Roberts has been appointed Master Mechanic of the Southern Iron Car Line, with office at Atlanta, Ga. Mr. Roberts was Superintendent of Motive Power of the South Carolina Railway for some years, but resigned that position in 1894.

Mr. Willard Kells, son of the late Ross Kells, has been appointed Master Mechanic of the Erie shops at Cleveland, O. Mr. Geo. Donahue, who formerly occupied the position, has been transferred to Meadville, Pa., to succeed Mr. F. B. Smith, resigned.

Mr. W. R. Setchel has been appointed Master Mechanic of the Wheeling & Lake Erie Railroad, to succeed Mr. O. P. Dunbar, with headquarters at Norwalk, O. Mr. Setchel is the son of Mr. J. H. Setchel, General Agent of the Pittsburgh Locomotive & Car Works.

Mr. F. W. Brazier, formerly Superintendent of the Chicago, New York & Boston Refrigerator Company, and located at Elsdon, Ill., has been appointed General Foreman of the Car Department of the Illinois Central Railroad and will have charge of all car work at the new Burnside shops of the company.

Mr. W. J. Spicer, General Manager of the Chicago & Grand Trunk, the Detroit, Grand Haven & Milwaukee, and other Grand Trunk roads west of the Detroit River, has resigned, after 12 years of service in that position. The duties of the office will be performed by the General Manager of the Grand Trunk at Montreal.

Mr. Arthur M. Parent has been appointed Manager of the Pullman Works of the Pullman Palace Car Company, to succeed Mr. Harvey Middleton, who resigned in January. Mr. Middleton was with the company since 1891, previous to which he had occupied prominent positions in the railroad service, among which were the positions of Superintendent of Motor Power on the Union Pacific, on the Atchison, Topeka & Santa Fe and on the Louisville & Nashville.

Mr. R. D. Wade has resigned from the position of Superintendent of Motive Power of the Southern Railway, and Mr. W. H. Thomas has been appointed his successor. Mr. Wade began his railroad career in 1857, and since that date has been on Southern roads and chiefly on lines now in the control of the Southern Railway. Mr. Thomas was Superintendent of Motive Power of the East Tennessee, Virginia & Georgia before it was absorbed by the Southern Railway.

Mr. John K. Cowen, formerly General Counsel for the Baltimore & Ohio Railroad, has been elected President of the road. Vice-President Orlando Smith has resigned, and his place has been filled by the appointment of Mr. Oscar G. Murray, formerly Second Vice-President of the Big Four. Mr. Smith retains the Presidency of the Baltimore & Ohio & Chicago Railroad, the Pittsburg & Connellsville Company, and the Parkersburg Branch Railroad Company, and other branch lines of the Baltimore & Ohio. Second Vice-President T. M. King has also resigned, and has accepted the Presidency of the Baltimore & Ohio Southwestern.

Mr. C. C. Waite, President of the Columbus, Hocking Valley & Toledo Railway, and who for more than a week had been ill of pneumonia in his private car at Columbus, O., died on Feb. 21. Mr. Waite entered railroad service in 1864, and became Chief Engineer of the Cincinnati & Muskingum Valley in 1869, with which road he remained until 1881. For one year he was assistant to the President of the New York, Lake Erie and Western, and from 1882 to 1889 he held the position of Vice-President of the Cincinnati, Hamilton & Dayton. In 1889 he was made President of the Hocking Valley, which position he held at the time of his death.

Mr. F. D. Adams has resigned the position of Master Car Builder of the Boston & Albany Railroad, on account of advanced age. He was born Aug. 30, 1822. He began car work in 1847 and entered railway service in 1850. From 1850 to 1868 he was Master Car Builder of the Buffalo & Lake Erie Railroad, now a part of the Lake Shore & Michigan Southern, and for the next two years was Superintendent of the Ohio Falls Car Company. In 1870 he was appointed to the position he has just resigned. He has always been active in association and club work, and was one of the founders of the Master Car Builders' Association. Though retired from active service, his many friends will be pleased to again meet him at the conventions of this Association, in which he has been such a familiar figure.

Box Car of 60,000 Pounds Capacity with Steel Sills —Chicago, Burlington & Quincy Railroad.

The box car of 60,000 pounds' capacity that has been standard on the Chicago, Burlington & Quincy Railroad for several years past has the draft rigging on the center sills, the drawbar stem passing through the end-sill. This construction, combined with an excellent draft gear, gave perfect satisfaction. But the mechanical department believes that some day dead-blocks will be used in conjunction with M. C. B. couplers, and to apply dead-blocks to cars with draft gears between the sills would require them to be above the plane of the floor sills. For this reason the standard design was modified recently, and the floor of the car raised with reference to the coupler and draft gear.

In making the change it was decided to keep the draft gear on the center sills as heretofore, and consequently these sills were placed six inches lower than the intermediate and side sills, and filling blocks or timbers extending the whole length of the car were fitted between them and the floor. This requires about the same amount of material as where ordinary draft timbers are employed and filling pieces under the sills are employed to make them practically continuous for the length of the car, but the single and more substantial piece of timber is in this case placed in the direct line of thrust from the draft and gear without impairing its utility as a floor beam.

The mechanical department then went a step further and built a sample car, in which the center sills are steel channels, as shown in the accompanying illustrations. They are placed in the same position as the wooden sills referred to above, except that their tops are only 5 inches below the floor because of the greater depth of the channels. The latter are 10 inches deep and weigh 25 pounds per foot. Fig. 1 contains cross-sections at the bolster and needle beam and shows clearly the arrangement of parts. The bolster is very deep, 16¾ inches over all at the center, and its plates 10 inches wide. Castings between the center and intermediate sills strengthen the bolster and cause it to retain its strength and stiffness regardless of any shrinkage of the wood. Between the center sills a wrought iron strap of ¾ inch by 10-inch iron unites the parts, and outside of the intermediate sills a casting fills the space between the plates of the transom and takes the pressure of the side bearing. The construction at the needle-beam is clearly shown. The 2-inch timber between the intermediate and side sills only extends from one needle-beam to the other. Straps ¾ inches by 3 inches unite the center sills at each needle-beam.

One thing is noticeable from Fig. 3 and that is the absence of bolts or rivets in the flanges of the channels. This has been done to avoid weakening them. From Fig. 2 it will be seen that between the ends of the center sills and the inside faces of the end sills a ½-inch plate is inserted and the channels are secured to it by angle iron brackets. A detail of one-half of the plate is given. This Fig. 2 also shows the draft gear, which has been such a success and which originated on this road. The stops are steel plates bent over double and are riveted to steel check plates, the ends of which are bent out to help retain the stops in place. The whole is riveted to the inside faces of the channel sills. The carrier irons are double and the dead wood is protected by a 4 by 4 by ⅜-inch angle iron, as shown.

This box car is probably the first one intended for regular service to be equipped with steel center sills, and marks another advance in the use of metal in car construction. The road has for some time used steel channels for the center sills of tender frames.

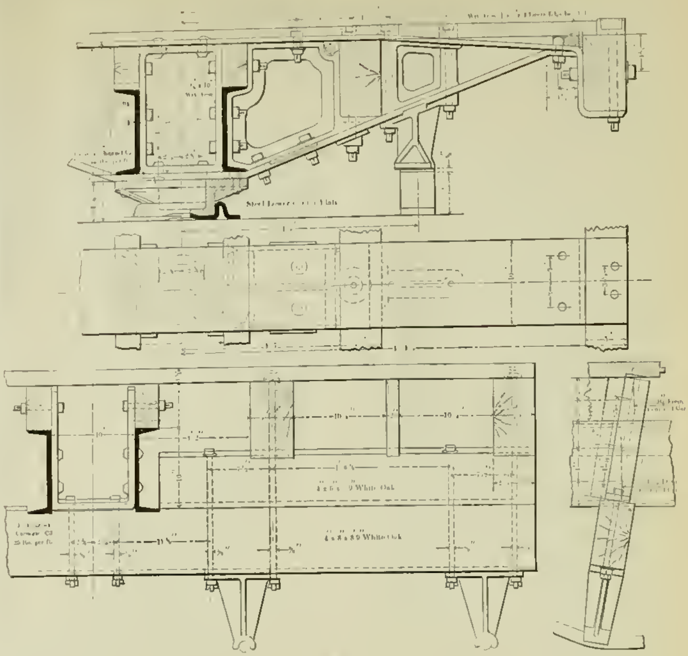


Fig. 1.

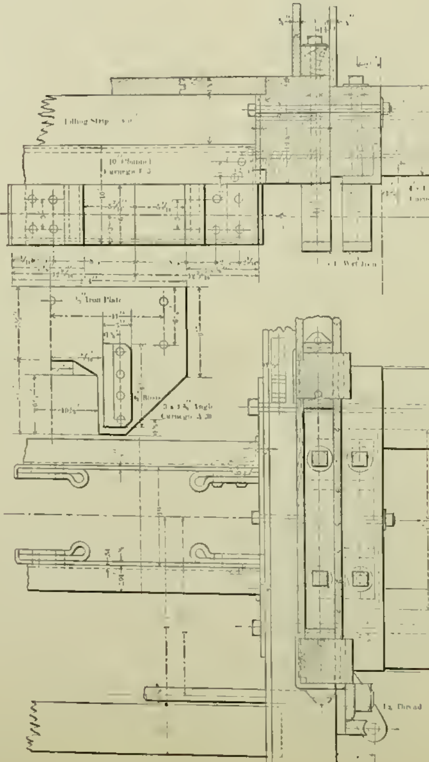


Fig. 2.—Box Car of 60,000 Pounds Capacity with Steel Sills.—Chicago, Burlington & Quincy Railroad

Daniel Kinnear Clark

The death of Mr. Daniel Kinnear Clark severs another of those links with the railways of the past now all too few. Albeit he never carried out any great engineering work, he was a noteworthy man, and will not soon be forgotten. He died at his residence, 8 Buckingham street, Adelphi, on Jan. 22, aged 71. Of his early years and parentage little is known. We first hear of him as an apprentice in the Phœnix Iron Works, Glasgow. Subsequently he was an assistant to Mr. Miller, who had an extensive practice as a civil engineer in Edinburgh. Mr Miller had a good deal to do with railways, and after young Clark had been with him for three years, he was appointed Locomotive Superintendent to the Great North of Scotland Railway. While there he was diligent in obtaining information on the performance of locomotives, consumption of fuel, train resistance, etc. For some reason, however, probably inherent in the man, he does not seem to have taken kindly to practical engineering. So long as experiments or investigations were to be carried out or conducted, he was happy; but the everyday routine duties of an engineer in a responsible position did not appear to suit him. He had a strong literary bent. In 1855 he published his book on the locomotive engine and the machinery of railways. Nothing so complete and altogether satisfactory had been published before; nothing equal to it has appeared since. To this moment Clark's book is a standard work of reference. Of course, the lapse of time has rendered much that it contains obsolete. Locomotives of much greater power than Clark dreamed of are running, but the fact remains that Clark made scarcely any mistakes.

The success of his book was so great that Mr. Clark left the Great North of Scotland Railway and started in business as consulting engineer in London. In 1857 he established himself in 8 Buckingham street, Adelphi, and there for

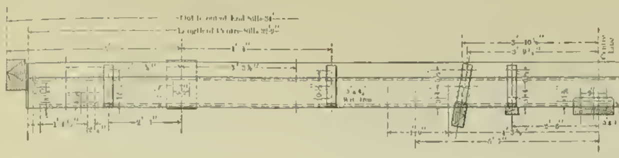


Fig. 3.—Steel Sill for Box Car—C. B. & Q. R. R.

forty years he lived and worked. Of how few can a similar story of long residence be told! The fact bears testimony to the remarkable adhesiveness of the man. He had no desire to wander; he did curiously little to bring himself into notice, and yet where is the engineer of the last generation who did not know D. K. Clark either personally or by reputation

In 1861 it became necessary to appoint an engineer to take charge of the machinery department of the International Exhibition of 1862. The choice devolved on Mr. Clark, and he carried out the work and discharged the duties with a skill and tact and an abscence of friction worthy of all praise. His employment at the exhibition just suited him, and he there conducted several experiments, the most noteworthy perhaps being a trial of centrifugal pumps. Then he wrote a book, "The Exhibited Machinery of 1862," which, if it did not add to his reputation, constituted a most useful volume for reference.

During the next few years we find him acting as judge for the Hoyal Agricultural Society and carrying out experiments, almost always in connection with steam or fuel. In connection with the Smoke Abatement Exhibition at South Kensington in 1881 he conducted an elaborate series of experiments and his treatise on the subject, embodying the results of his experiments, may be said to contain all that is known or worth knowing concerning the domestic consumption of fuel.

But before this, that is, to say in 1877, he produced the book which will do more to keep his name alive than any other which he wrote, we refer to "A Manual of Rules, Tables and Data for Mechanical Engineers." Those who have this volume—and they include, no doubt, the great majority of mechanical engineers—know that there is no other work like it. Is it not a volume in which we can always find just the information sought? Of how many reference volumes can that be said? The work has gone through several editions. In 1878 he brought out a small volume on "Tramway Construction," subsequently much enlarged and improved, and in 1892 his work on "The Steam Engine and Boilers," which deserves to rank with the very best treatises ever written. This was the last work of any importance Mr. Clark accomplished. During the last few years his health has been gradually failing; of late years he lived a very retired life and was seldom seen in public. He was a member of the Institution of Civil Engineers, joining that body as far back as 1854, and he contributed to it no fewer than eight papers, among which those on the "St. Gothard Tunnel," "Railway Locomotive Stock" and "The Evaporative Performance of Steam Boilers" deserve special mention.—*The Engineer.*

The Most Advantageous Dimensions for Locomotive Exhaust Pipes and Smoke Stacks.*

BY INSPECTOR TROSKE.

(Continued from page 31.)

The results obtained from the experiments described in our last issue are shown in the accompanying tables. The highest and lowest value for the vacuum that were observed are not given in the engravings, but an average is taken, as we have already signified, from which there was very little variation. In the diagrams on Plate I., published last month, and Plate II., found in this issue, the space between two adjacent abscissa points denotes a distance in actual practice of 1.57 inches, while the two adjacent points on the axis of ordinates denote a distance of .39 inches.

Experiments were made with two kinds of conical stacks, namely those with and without a reverse inclination. The first are called the waist stacks and the latter the funnel stacks in what follows. In the waist stacks the smallest diameter was located 17.52 inches above the bottom edge, while in the latter this smallest diameter was at the very bottom. All of the stacks had the same heighth of 5 feet 7.08 inches, as shown in Fig 29 of our last issue. In order to have a definite arrangement for the comparison of the data obtained from the two forms of stack, the waist stack was placed with its smallest section at the same distance from the nozzle opening as was the smallest portion of the funnel stack, whence the nozzle was 17.52 inches above the bottom of the former when it was exactly flush with the bottom of the latter. Hence, upon all of the tables the same figures are given for the same abscissas indicative of the blast-nozzle distances.

The nozzle was held off 1.38 inches from the top of the air chamber of the apparatus. Hence, the shortest distance at which the nozzle could work in all of the experiments was 18.9 inches from the waist of the stack.

III.—EXPERIMENTS WITH FULL-LENGTH STACKS.

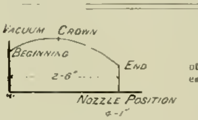
CYLINDRICAL STACKS

In plate I. the vacuum obtained with each of the five experimental stacks, with the five different positions of the blast nozzle, is given graphically. The vacuum obtained with each diameter of blast nozzle, with the five different smokestacks, is also shown. It appears, then, from these groups of curves that, other conditions being the same, the vacuum increases as the stack is made smaller, and the distance to the nozzle increased. Both of these conditions, however, only hold good near the upper limits; for as the curves under (*B*) show, the difference in the vacuum produced by two consecutive stacks becomes less as the stacks are smaller. These variations are also different for different diameters of blast nozzle (the steam pressure remaining the same) and decrease as the distance to the nozzle increases.

TABLE II.

CYLINDRICAL STACKS.

Diameter of stack in inches.		Vacuum in inches of water with a nozzle diameter of 3.94 in.	4.33 in.	4.74 in.	5.12 in	5.51 in
13.78	Beginning	3.96	4.23	4.53	4.57	4.53
	Crown	4.04	4.29	4.59	4.61	4.53
	End	3.50	3.62	3.76	3.74	3.50
14.76	Beginning	3.70	4.14	4.37	4.45	4.45
	Crown	3.94	4.28	4.57	4.65	4.57
	End	3.64	3.82	4.02	4.06	3.90
15.75	Beginning	3.43	3.76	4.09	4.23	4.29
	Crown	3.74	4.06	4.37	4.51	4.45
	End	3.52	3.82	4.09	4.19	4.08
16.73	Beginning	3.11	3.45	3.78	4.33	4.04
	Crown	3.50	3.81	4.13	4.29	4.33
	End	3.43	3.72	4.02	4.13	4.11
17.72	Beginning	3.80	3.11	3.45	3.62	3.71
	Crown	3.25	3.56	3.90	4.06	4.09
	End	3.25	3.56	3.90	4.06	4.09



NOTE.—The crown or crest of the curve marks the highest vacuum produced.

Referring to Table II, which marks the three characteristic points of each curve, we find that the differences between the values given for the beginning of the curves, for a nozzle diameter of 3.94 inches (starting with the stack of greatest diameter) is 0.31 inch, 0.32 inch, 0.27 inch and 0.26 inch, and where the nozzle diameter is 5.51 inches, these differences are only 0.30 inch, 0.25 inch, 0.16 inch and 0.08 inch. For the first diameter of nozzle, therefore, the limit of diameter for the stack is about 9.84 inches, at which point the vacuum rises to the ratio laid down, the nozzle distance being 18.9 inches, which means that for a diameter smaller than this, the vacuum falls off. For a nozzle diameter of 5.51 inches, the smallest stack has a diameter of about 13.37 inches.

Those stacks giving the greatest indraft of air, as we have shown in the historical portion, have been mistaken by different investigators as being the most efficient, while in reality, they are entirely unsuited to locomotives with nozzles much smaller than those used on the apparatus, on account of the large size of the cinders carried through the tubes and the sparks that are thrown.

If, for a given diameter of nozzle we take the stack diameters as abscissas, and the corresponding vacuums produced as ordinates, we obtain a curve like that shown in Fig. 30, illustrating the rise and fall of the vacuum with the changing diameters of the stacks. We see that, in this case, the graphical representation cannot be taken as the sole indicator of the efficiency of the action of the stack.

The increase in the vacuum, with the increasing distance to the nozzle, naturally becomes greatest with the largest stack. This amounts, for example, to 0.45 inch for an increase of this distance from 18.9 inches to 4 feet 1 inch, and with nozzle diameters equal to 3.94 inches and 4.74 inches as indicated in Fig. 31, for the smallest diameter of nozzle this gives an increase of 16 per cent. This would have been still greater if experiments had been made with an original distance less than 18.9 inches. This last distance is really too great for a stack 13.78 inches in diameter, as the corresponding curve in Plate II. shows. These diagrams also show that the diameter of the cylindrical stacks must be from 3.7 to 3.8 times the diameter of the nozzle.

Near its highest point the curves are usually nearly straight, and then they begin, on account of the frictional losses, due to the contact of the current of steam against the stack, to take a sharper curvature, corresponding to the fall of the vacuum, and come down toward the axis of abscissas.

If we take for the abscissa of the highest point of the curve, the average values of five different nozzle openings, as given in Table II., the maximum vacuum for the stack is obtained:

With a diameter of 13.78 inches, with a nozzle distance of 1 foot, 10.72 inches, or 1.63 times the stack diameter,
with a diameter of 14.65 inches, with a nozzle distance of 2 feet 4.35 inches, or 1.95 times the stack diameter;
with a diameter of 15.75 inches, with a nozzle distance of 2 feet 9.31 inches, or 2.13 times the stack diameter;
with a diameter of 16.73 inches, with a nozzle distance of 3 feet 0.22 inch or 2.16 times the stack diameter,
with a diameter of 17.72 inches, with a nozzle distance of 3 feet 0.36 inches, or 2.39 times the stack diameter.

Therefore, we may take as an average for the distance of the nozzle, twice the diameter of the stack. But since the vacuum diminishes each way on the curve from the crest, it is best to make the nozzle distance less than the abscissa of the crest of the curve, or, in other words, the nozzle distance should be made less than twice the diameter of the stack. As a practical rule and one which has been successfully applied to different locomotives, we may put the nozzle distance at from $1\frac{1}{4}$ to $1\frac{1}{2}$ times the stack diameter.

The maximum vacuum is produced if the total height of the stack is made from 4.6 to 4.7 times the stack diameter. This is clearly shown in Table III.

TABLE III.

Diameter of stacks in inches.	The maximum vacuum will be obtained if the distance from the nozzle to the top of the stack is equal to that given in inches below when the nozzle diameter is 3.94 in.	4.33 in.	4.74 in.	5.12 in	5.51 in.	The ratio of the total height of the stack to its diameter thus averages
13.78	5' 5.35"	5' 3.07"	5' 3.00"	5' 2.21"	4' 11.00"	4.5
14.76	5' 10.87"	5' 10.08"	5' 9.20"	5' 8.50"	5' 6.14"	4.6
15.75	6' 2.80"	6' 2.02"	6' 1.23"	6' 0.15	5' 10.06"	4.6
16.73	6' 6.74	6' 5.16"	6' 4.48"	6' 3.59	6' 2.02"	4.6
17.72	6' 9.18	6' 11.15"	7' 0.25	6' 10.68"	6' 9.10"	4.7

From the foregoing we come to the following conclusion:

With cylindrical stacks the total distance from the nozzle to the top of the stack should not be more than 4.7 times the diameter of the stack.

If Nozo and Geoffrey found the greatest draught to be created with a height of stack equal to from six to seven times its diameter, it was certainly due to the small dimensions of their experimental apparatus producing such variations as also caused them to declare that the nozzle should be located close to the lower end of the stack. (At that time it was common practice to place the nozzle flush with the latter.)

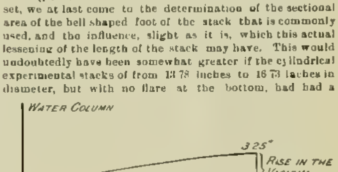


Fig. 30

From the Hanover experiments, then, and in consequence of the greater distance at which the blast nozzle has been set, we at last come to the determination of the sectional area of the bell shaped foot of the stack that is commonly used, and the influence, slight as it is, which this actual lessening of the length of the stack may have. This would undoubtedly have been somewhat greater if the cylindrical experimental stacks of from 13.78 inches to 16.73 inches in diameter, but with no flare at the bottom, had had a

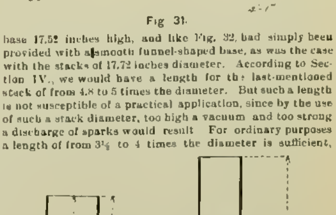


Fig. 31.

base 17.52 inches high, and like Fig. 32, had simply been provided with a smooth funnel-shaped base, as was the case with the stacks of 17.72 inches diameter. According to Section IV., we would have a length for the last-mentioned stack of from 4.8 to 5 times the diameter. But such a length is not susceptible of a practical application, since by the use of such a stack diameter, too high a vacuum and too strong a discharge of sparks would result. For ordinary purposes a length of from $3\frac{3}{4}$ to 4 times the diameter is sufficient,

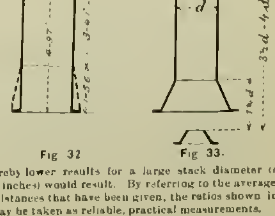


Fig. 32. Fig. 33.

whereby lower results for a large stack diameter (about 17.72 inches) would result. By referring to the average nozzle distances that have been given, the ratios shown in Fig. 33 may be taken as reliable, practical measurements.

(B) CONICAL STACKS.

What has just been said regarding cylindrical stacks can also be accepted as true, in a general way, for conical stacks. Except that it appears to be far more sensitive to the nozzle location, since the increase of vacuum with it for the same increase in nozzle location is evidently greater than with the cylindrical stack. This increase for an inch drop in the nozzle becomes more rapid the sharper the flare of the stack

* Paper read before the German Society of Mechanical Engineers.

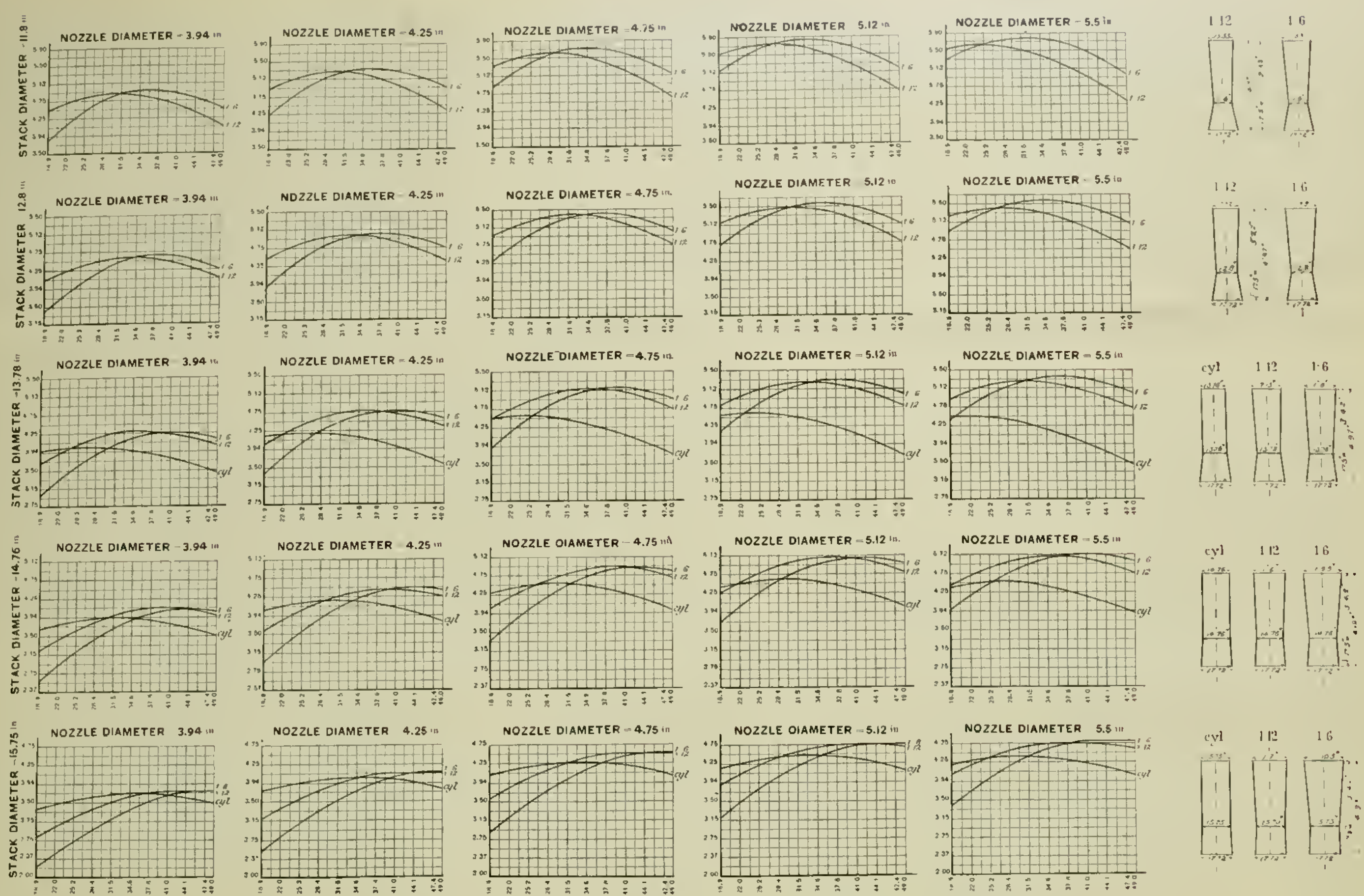


PLATE II.—COMPARISON OF THE ACTION BY CYLINDRICAL AND CONICAL STACKS (HANOVER EXPERIMENTS.)

Note 1. The abscissas give the distance of the top of the blast nozzle below the smallest diameter of the stack; the ordinates denote the corresponding vacuum in inches of water.
2. The curves are plotted from an average of the values obtained, and they vary from the maxima and minima observed by from .02 to .08 inch.
3. All of the observations were made with the same steam pressure (3.94 inches of mercury) and with the same opening for the admission of air.
4. The figures at the right hand end of each curve are the diameters of the corresponding blast nozzle or stack.

toward the top (of course within certain limits), as an examination of the curves under II. and III. in Plate I will show, where the curves under II. are very markedly flatter than under III. These results are here tabulated under Tables IV. and V., for convenient reference. Here we take for our example a stack having a maximum diameter of 15.75 inches and a nozzle diameter of 3.94 inches, the vacuum increasing with the increasing distance of the nozzle—for stacks having an inclination of $\frac{1}{12}$, the increase was about 0.96 inches, or 34 per cent., and with one having an inclination of $\frac{1}{6}$ it was 1.61 inch, or about 76 per cent.

TABLE IV.

CONICAL STACKS WITH AN INCLINATION OF $\frac{1}{12}$.

Stack Diameters in inches		Vacuum in inches of water column with nozzle diameters of				
		3.94 in.	4.33 in.	4.74 in.	5.12 in.	5.51 in.
11.81	Beginning	4.49	4.92	5.35	5.53	5.65
	Crown	5.90	5.29	5.63	5.75	6.67
	End	3.91	4.43	4.65	4.69	4.11
12.80	Beginning	4.08	4.49	4.96	5.15	5.24
	Crown	4.63	5.03	5.41	5.49	6.43
	End	4.13	4.45	4.74	4.78	4.53
13.78	Beginning	3.66	4.06	4.51	4.78	4.90
	Crown	4.37	4.78	5.15	5.28	5.28
	End	4.09	4.45	4.71	4.78	4.71
14.76	Beginning	3.25	3.62	4.06	4.33	4.49
	Crown	4.13	4.49	4.94	5.11	5.12
	End	3.98	4.33	4.69	4.76	4.75
15.75	Beginning	2.82	3.17	3.58	3.86	4.06
	Crown	3.78	4.13	4.55	4.74	4.74
	End	3.78	4.13	4.55	4.69	4.65

TABLE V.

CONICAL STACKS WITH AN INCLINATION OF $\frac{1}{6}$.

Stack diameters in inches.		Vacuum in inches of water column with nozzle diameters of				
		3.94 in.	4.33 in.	4.74 in.	5.12 in.	5.51 in.
11.81	Beginning	3.84	4.31	4.88	5.15	5.32
	Crown	4.98	5.35	5.73	5.87	5.80
	End	4.53	4.93	5.15	5.19	5.02
12.80	Beginning	3.43	3.86	4.37	4.69	4.92
	Crown	4.65	5.06	5.41	5.59	5.59
	End	4.35	4.74	5.06	5.12	5.10
13.78	Beginning	3.02	3.41	3.88	4.21	4.45
	Crown	4.33	4.77	5.15	5.32	5.36
	End	4.21	4.61	4.96	5.06	5.06
14.76	Beginning	2.58	2.95	3.37	3.70	3.96
	Crown	4.12	4.53	4.92	5.10	5.14
	End	4.06	4.47	4.86	4.98	5.02
15.75	Beginning	2.15	2.48	2.85	3.17	3.41
	Crown	3.78	4.15	4.57	4.74	4.80
	End	3.78	4.15	4.57	4.74	4.80

With the same minimum sectional area, and starting with the same nozzle distances, the stack having an inclination of $\frac{1}{12}$ gives a higher vacuum than the stack with an inclination of $\frac{1}{6}$; but the latter creates the same draught if the distance to the nozzle is correspondingly increased. At the same time the two forms of stacks give the same maximum

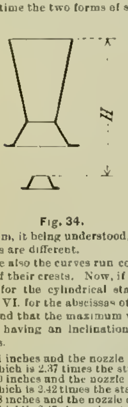


Fig. 34.

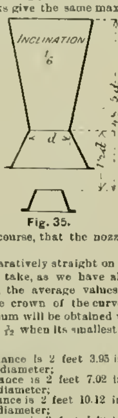


Fig. 35.

vacuum, it being understood, of course, that the nozzle distances are different.

Here also the curves run comparatively straight on either side of their crests. Now, if we take, as we have already done for the cylindrical stacks, the average values from Table VI. for the abscissas of the crown of the curves, we will find that the maximum vacuum will be obtained with a stack having an inclination of $\frac{1}{12}$ when its smallest diameter is.

- 11.81 inches and the nozzle distance is 2 feet 3.95 inches, which is 2.37 times the stack diameter;
- 12.80 inches and the nozzle distance is 2 feet 7.02 inches, which is 2.42 times the stack diameter;
- 13.78 inches and the nozzle distance is 2 feet 10.12 inches, which is 2.47 times the stack diameter;
- 14.76 inches and the nozzle distance is 3 feet 1.48 inches, which is 2.53 times the stack diameter;
- 15.75 inches and the nozzle distance is 3 feet 4.79 inches, which is 2.59 times the stack diameter.

So that for an average the nozzle distance may be taken to be 2.5 times the stack diameter.

With a stack having an inclination of this maximum vacuum will be obtained when its smallest diameter is:

- 11.81 inches and the nozzle distance is 2 feet 9.7 inches, which is 2.85 times the stack diameter;
- 12.80 inches and the nozzle distance is 3 feet 0.62 inches, which is 2.86 times the stack diameter;
- 13.78 inches and the nozzle distance is 3 feet 3.61 inches, which is 2.87 times the stack diameter;
- 14.76 inches and the nozzle distance is 3 feet 6.91 inches, which is 2.90 times the stack diameter;
- 15.75 inches and the nozzle distance is 3 feet 10.22 inches, which is 2.93 times the stake diameter,

So that, for an average, the nozzle distance may be taken at 2.9 times the smallest diameter of the stack.

Now, since the sharp downward inclination of the curves begins at an earlier point on the crown with the conical stacks than it does with the cylindrical, so the maximum results will be obtained with far lower values than is possible with cylindrical stacks. It is, therefore, recommended that, with stacks having an inclination of $\frac{1}{6}$, the nozzle distance should not be more than twice the smallest diameter of the stack. According to observations made upon locomotives the following rule may be considered to prevail: *A nozzle distance from 1⅔ to 2 times the stack diameter is an effective one.* This can also be applied to stacks of other inclinations.

The total height H, at which the strongest draught is obtained, is shown for both the $\frac{1}{12}$ and $\frac{1}{6}$ inclinations in Table VI. An examination of Table II. shows that the height H, Fig. 34, for the conical stack, is greater than that for the cylindrical stack, and that this increases as the opening of the stack at the top is greater

This ratio relatively to the diameter may be taken to average as follows:

Cylindrical stack	4.6
Conical " $\frac{1}{12}$ inclination	5.4
" " $\frac{1}{6}$ "	5.8

Again, while this ratio increases with the increase of diameter of the cylindrical stack, it decreases with the conical stack as the inclination is increased.

The maximum heights of vacuum given in Tables III. and VI., taken roughly, are applicable only to stacks whose upper portion above the smallest sectional area is 3 feet, 4 inches long. If we make this latter distance greater, the total stack height falls still more, always, of course within certain limits.

From the applications given above and those given in Sections IV. and V., we can determine the maximum values of the ratios of the total height of the stack to the diameter, which may be stated, in round numbers, to be for:

Cylindrical stacks, about	5
Conical stacks with $\frac{1}{12}$ inclination, about	6
" " " $\frac{1}{6}$ " "	6½

Furthermore, these are not exact values, since those previously given are too great for actual service and for the same reasons as that assigned for the cylindrical stacks. We, therefore, reach the following conclusion:

When the waist diameter of the conical stack is carefully chosen, the total height should not be more than five times this diameter.

For a perfectly satisfactory construction, the ratios given in Fig. 35 will be found to yield effective dimensions. But when the diameter is 14.17 inches or more, we must use the smaller dimension ($4\frac{1}{2}d$).

(To be Continued.)

The New Baldwin-Westinghouse Electric Locomotives.

The Westinghouse Electric and Manufacturing Company has received the first electric locomotive manufactured under the arrangement entered into some time ago between Westinghousethe Company and the Baldwin Locomotive Works of Philadelphia. It is shown in the accompanying engraving, from which it will be seen to be a radical departure in construction from any electric locomotive hitherto manufactured. It is 38 feet long and 9 feet wide over all. All the operating parts of the locomotive have been placed on the trucks and the body of the car will only contain the controlling apparatus, and can be utilized as a receptacle for such appliances as are usually carried by

Baldwin-Westinghouse Electric Locomotive.

any train. It may also be used as a freight or baggage car.

It is carried on four pairs of wheels arranged in two trucks that are constructed in a very substantial manner. The wheels are 42 inches in diameter. There will be four motors of 250 horse-power, each connected to an axle of the locomotive. Thus the entire weight of the locomotive will be available for adhesion. The locomotive completely equipped weighs 160,000 pounds. The motors are geared, which method was decided upon so as to enable the company to use more efficient and durable motors, and also to greatly reduce the cost of the locomotive. It is stated that while the electric locomotive used in the Baltimore tunnel cost about $50,000, the Baldwin-Westinghouse locomotive cost less than one-third of that amount, and yet it will be able to accomplish the same work. Locomotives will be manufactured for tunnel work, suburban traffic and rack locomotives, as well as for elevated railroads. By the time this paper reaches our readers the second locomotive completed by the Baldwin people will be received at the East Pittsburgh factory of the Westinghouse Electric and Manufacturing Company. This last one will be of the elevated railroad type, and is an example of a motor car of the Manhattan Elevated Railroad of New York.

As far as the speed of the new locomotive we illustrate is concerned, it may be stated that the motors have been geared to produce a speed of 75 miles an hour. The locomotive is equipped with air-brakes, which are operated in the usual manner, and are supplied with air by a pump underneath the car driven by an electric motor.

The locomotive has been designed so as to be utilized with any method of electric traction. It can be used with the trolley system, the third rail system, the Westinghouse electro-magnetic system, and can also be utilized in connection with the Tesla polyphase system.

Since it has become known that the Baldwin-Westinghouse companies are constructing electric locomotives, enquiries have come from all over the world for such machines, indicating the wonderful demand there is for such engines when manufactured by well known and reliable firms.

Centrifugal Sand-Mixing Machine.

The firm of William Sellers & Company, Incorporated, Philadelphia, has recently brought out a simple and effective sand-mixing machine, that has resulted in a great saving of labor wherever used, besides more thoroughly mixing the sand for the molder. At a recent meeting of the Foundrymen's Association, Mr. A. E. Outerbridge read a paper on

Fig. 1.—Sand Mixing Machine.

molding sand in which he described the machine, and the following quotations from his paper state the conditions which led up to its introduction:

"Whatever special proportions of sand are used in foundries the same necessity exists in all for thoroughly mixing the old and new materials, and until comparatively recently the old methods of riddling and spading were adhered to. A

TABLE VI.

Diameter of stack in inches.	The highest vacuum is obtained when the total height of the stack measuring from the nozzle to the top of the stack is equal in inches to the figures given below, when the nozzle diameter is: 3.91 inches. Inclination $\frac{1}{12}$.		3.91 inches. Inclination $\frac{1}{6}$.		4.33 inches. Inclination $\frac{1}{12}$.		4.33 inches. Inclination $\frac{1}{6}$.		4.74 inches. Inclination $\frac{1}{12}$.		4.74 inches. Inclination $\frac{1}{6}$.	
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
11.81	5	10.08	6	1.48	5	9.69	6	3.59	5	8.50	6	2.02
12.80	6	1.23	6	6.31	6	0.84	6	5.95	5	11.66	6	9.10
13.78	6	4.18	6	9.50	6	3.79	6	9.1?	6	2.80	6	8.31
14.76	6	7.53	7	0.65	6	6.71	7	0.26	6	6.31	6	7.53
15.75	6	9.89	7	4.19	6	10.68	7	3.80	6	9.11	7	2.02

Diameter of stack in inches.	5.12 inches. Inclination $\frac{1}{12}$.		5.12 inches. Inclination $\frac{1}{6}$.		5.51 inches. Inclination $\frac{1}{12}$.		5.51 inches. Inclination $\frac{1}{6}$.		The average ratio of the total height of the stack to the diameter of the same. Inclination $\frac{1}{12}$	The average ratio of the total height of the stack to the diameter of the same. Inclination $\frac{1}{6}$.
	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.		
11.81	5	7.72	6	0.45	5	4.57	5	10.87	5.77	6.25
12.80	6	2.41	6	3.9	5	7.72	6	2.80	5.54	6.01
13.78	6	1.23	6	6.73	5	10.87	6	5.16	5.38	5.78
14.76	6	4.77	6	9.80	6	2.80	6	9.10	5.26	5.62
15.75	6	8.31	7	1.04	6	6.74	7	0.26	5.11	5.48

few years ago the firm of William Sellers & Company began experimenting upon the preparation of molding and core sand by the aid of centrifugal force. The first machine was a comparatively crude affair, but when the correctness of the principle was demonstrated the apparatus was remodeled and greatly improved. This now thorough, practical and simple machine attracted the attention of visitors at various times and duplicates were made at the solicitation of the representatives of several of the largest establishments in Philadelphia These little machines then created for themselves a reputation, which was followed by a demand for more of them, and the apparatus illustrated herewith is now regularly manufactured by the Sellers company for sale.

"The machine is remarkable, both as a labor saver and as an improver of molding sand It accomplishes as much work by the helping of two laborers working three hours a

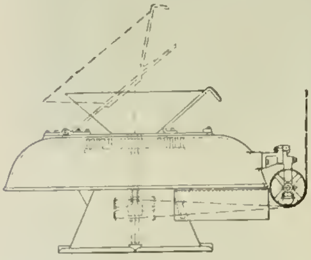


Fig: 2 —Sand Mixing Machine.

day in preparing facing sand as five men could do in 10 hours by the old method, and it is found that as the sand is much more uniformly mixed and tempered, its quality of toughness (without impairment of porosity) is decidedly improved "

The apparatus consists of a rapidly revolving table, having upon its upper surface a number of prongs grouped about a central axis The sand is fed through a hopper and thrown with great force from prong to prong, emerging from beneath the cover in a fine shower, free from lumps and thoroughly mixed. The hopper is hinged for convenience of cleaning the revolving plate and prongs, and for removing stones, nails, etc. Our illustrations show an exterior view in Fig. 1 and Fig 2 give the construction. The revolving table is carried on a vertical shaft which may be extended upward and driven from above by a belt, or if more convenient it may be belted from below as in Fig. 2. It is also adapted to be driven by an electric motor. Old sand which has been used in the foundry always contains nails, jaggers, iron scrap, etc., and new sand sometimes contains stones and other foreign substances Such materials should be removed by the screen before the sand is passed through the machine. Ordinarily good molding sand needs no prior sieving, but is shoveled while damp directly into the hopper The batches of "facing" and "core" sand are similarly treated. The sand falls upon the rapidly revolving plate, and is thrown with great force from one set of prongs to another, and then emerges from beneath the cover, more thoroughly mixed and better adapted for the molder's use than any amount of hand mixing could have made it.

Mr. J. S. Mundy, of Newark, N. J., the hoisting engine builder, has a contract for the New York Central & Hudson River Railroad for building the new drawbridge engine for the Spuyten Duyvil Creek draw. This drawbridge has a span of 200 feet The engine has double cylinders with reverse link motion and by means of gearing operates two lines of steel shafts, 4½ inches in diameter, for opening and closing the draw. The engine is specially arranged for operating their temporary lift draw that is now in use across the Spuyten Duyvil Creek, and as soon as the permanent drawbridge is erected, will be transferred to the new draw. All the material entering into the construction of this engine is of the highest grade and workmanship of the very best.

That the product of the Westinghouse Electric and Manufacturing Company is of world-wide demand has again been demonstrated recently by the company receiving orders to equip an electric railway in the Isle of Man; another order for electric railway apparatus for the city of Coventry, England; and a third order for electric motors and railway generators for Cape Town, South Africa The company is also about to ship an order for electric railway apparatus to Bangkok, Siam, India. The company is constantly constructing notable machinery for this country also. It recently shipped two of the largest electrical generators for the operation of an electric railway that have ever been turned out anywhere. These two machines are of 1,500 horse power each, and they were contracted for by the Nassau Electric Railway Company, of Brooklyn, N. Y.

The Chicago Tire and Spring Company announces that the business heretofore conducted by that company will hereafter be carried on by the Latrobe Steel Company, which has purchased the former company's plant at Melrose Park, Ill.

Superintendents of motive power and master mechanics will be interested to learn of a compound which is an absolute and permanent rust preventive for all bright parts of locomotives, tools and machinery. Mannocitin, made by Muller & Mann, Berlin, Germany, is such an article, and the fact that it has been adopted by the German Government railways and the leading iron and steel works will go to show that it has a great deal of merit. Mannocitin is composed of greases and volatile oils, leaving a thin, transparent film on the metal, which makes the latter impervious to weather and water and even fumes of muriatic acid and ammonia The Mannocitin coating is entirely neutral, is not rubbed off in handling but can be quickly removed with turpentine or petroleum.

The same manufacturers also make excellent "rust proof paints," which railways abroad use largely for painting car trucks, roofs and iron structures, and which will interest the master car painter of every railroad.

Mannocitin, as well as Muller & Mann's rust proof paints are being introduced into this country by Otto Goetze 15 Whitehall St., N. Y., who will be pleased to send particulars and free samples to any of our readers on application.

The Abbott Machine Company, of Chicago Heights, Ill., have sold their plant to the Q & C Company, of Chicago, of which W. L. Findlay is President, and Charles F Quincy, Treasurer. The Abbott company manufacture a check perforator, coin scales and other light machinery. These goods will now be made by the Q & C Company by contract. Additions will be made to the factory, the additions being larger than the old plant, and a foundry will also be built, so as to accommodate the work formerly done at the Q & C Company's shops at 2,634 Shields avenue, Chicago.

The orders for the Leach sanding apparatus for locomotives have amounted to nearly 100 per month for some time past. In January of this year the orders received were for 113 sets, which is the largest month's business thus far experienced with this ingenious device. There are nearly 2,500 locomotives now equipped with them. Those who have given the matter no particular attention should write Mr. H. L. Leach, 176 Huron avenue, North Cambridge, Mass., asking how much saving there is in the use of these sanders.

The Interchangeable Brake Beam Company, of St. Louis, have placed on the market a new metal beam that is to be known as the "Interchangeable." The compression member is of steel in tubular form and the tension member is a round rod The heads are of malleable iron and are alike for both ends of the beam, there being no rights and lefts. The strut is in two pieces so put together that they are practically one when the truss rod is in place, but by loosening the latter one of the parts can be turned so as to reverse the angle of the slot for the brake lever A rigid strut is employed if the purchaser prefers it A recent test of the beam by Professor Johnson, of Washington University, gave the following result:

Diameter of back strut, 2.41 inches.
Diameter of tie rod, 1.00 inch.
Weight of back strut, 20 pounds, 13 ounces.

Applied loads at center. Total pounds.	Deflections at center. Inches.
0	0.0
2,000	0.012
4,000	0 020
6,000	0 039
7,500	0 049
8,000	0.052
10,000	0.069
12,000	0.085
16,000	0.097
18,000	0.017
20,000	0 214
21,720	0.349
27,660	.

The beam broke at 27,600 pounds through failure of the tie rod, which broke in the threads. The strut did not fail. The deflection of the brake beam, as indicated above, was only 0.049 inches for a load of 7,500 pounds, or 20 per cent. less than the allowable deflection, which is $\frac{1}{16}$ inch.

Mr. Clarence S. Bement, of Bement, Miles & Company, Philadelphia, has recently been honored by the Royal Academy of Sciences, at Munich, Germany, which awarded him the silver medal, "Bene Merenti," for his services in the field of mineralogy. Though a busy man, Mr. Bement has found time to bring together a fine collection of minerals, and to do much to advance this science in which he is so greatly interested

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The Chicago Pneumatic Tool Company, 1553 Monadnock Block, Chicago, Ill., received last month another order from London for 10 of their pneumatic hammers, of the size used for flue beading and boiler calking.

Business is good with Messrs. W. A Crook & Brothers Company, Newark, N. J., the prominent builders of high-grade hoisting machinery, and they have just established a branch office at Boston, Mass., corner of Franklin and Pearl streets, to accommodate the increased business from that section. In addition to their large line of hoisting engines for building, pile driving and general contractors' use, W. A. Crook & Brothers Company build improved hoists for mining and other hoisting purposes, which operate by electricity, and which have become extremely popular

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The Clayton Air Compressor Works, Havemeyer Building, New York, report recent sale of a large duplex steam actuated air compressor of their latest improved pattern to the Pennsylvania Railroad Company for the various applications of this power in their Altoona shops. This company has orders for several large compressors from other railroad companies for their shop uses of compressed air, and are also doing a large business in smaller compressors for testing and inflating hose and bicycle tires and for supplying crude oil burners.

The Standard Boiler Company, of Chicago, report a good business during the past year. They have moved into their new offices, 1120 and 1121 Marquette Building The "Standard" boilers are built by the well-known firm, The Link-Belt Machinery Company, of Chicago, who have put in new and improved machinery for their manufacture, reducing their first cost as well as making the various parts interchangeable. During the past year a number of fine plants have been installed, among others being 4,000 horse-power for the North Chicago Street Railroad Company, at their new power station at Rawthorn avenue; 500 horse-power for the Cincinnati Edison Company, of Cincinnati, O.; 600 horse-power for the Western Electric Company at their factory in Chicago, and various others. The prospects are good for the year 1896.

Geo. S. Fowler, of Fort Wayne, Ind., who has a large acquaintance among the railroad trade, has accepted a position under the new management of the Kalamazoo Railroad Velocipede and Car Company as their traveling sales agent. This company has been doing business for the last 12 years as a co-partnership, but was incorporated Feb. 5, Mr. G. W. Miller retiring. The new officers are as follows. H. C. Reed, President; E. S. Roos, Vice-President; H. G Haines, General Manager, Secretary and Treasurer. Mr. Reed, the new President, is a capitalist having large interests in various manufacturing enterprises in Kalamazoo. The new management proposes to enlarge and increase its facilities for manufacturing, and to furnish goods of unexcelled quality in its line so as to merit increased confidence and continued orders. The company shipped last month one each of their No. 9 "Special" steam inspection cars and 2 horse-power gasolene motor cars to Australia. They also shipped recently one 8 horse-power gasolene motor car to Mississippi, and one No. 9 "Special" steam inspection car to Buenos Ayres, South America.

From New York to Florida.

FLORIDA can be reached by the New York & Florida Short Line Limited. A train of Pullman's most modern build, elegantly appointed, and has all requirements of first-class travel, a compartment, observation, library, dining and sleeping car, and is operated solid between New York and St. Augustine, carrying Pullman drawing-room sleeping cars from New York to Augusta and Tampa Asheville, Nature's Sanitarium, located in the mountains of western North Carolina, is reached in twenty-two hours from New York, via the Southern Railway, in Pullman drawing-room sleeping cars.

Our Directory

OF OFFICIAL CHANGES IN FEBRUARY.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atchison, Topeka & Santa Fe.—Mr. J Foster has been appointed Master Mechanic at La Junta. Colo., vice Mr. I. Conroe

Baltimore & Ohio.—John K Cowen has been chosen President to succeed Mr. C F Meyer; Mr. Oscar G. Murray appointed First Vice-President, to succeed Mr. Orlando Smith, resigned. Second Vice President T. M. King has resigned.

Baltimore & Ohio Southwestern.—Mr. T. M King has been elected President.

Beech Creek.—George Thompson has been appointed Master Mechanic, with headquarters at Jersey Shore, Pa

Boston & Albany.—Mr. F. D. Adams has resigned the position of Master Car Builder.

Buffalo & Susquehanna.—Master Mechanic J. D. Campbell has resigned, to take effect when his successor has been appointed.

Canadian Pacific.—Mr. R. Atkinson, who has been Acting Mechanical Superintendent, has been given the title of Mechanical Superintendent.

Central of Georgia.—Mr. H. M. Comer has been elected President of the road

Chester & Lenoir.—Mr. G. W F. Harper, President, has been appointed Receiver.

Chicago & Grand Trunk.—C. M Hays, by virtue of his appointment as General Manager of the Grand Trunk, becomes President of the Chicago & Grand Trunk. Mr W J. Spicer, General Manager of this and other Grand Trunk properties west of the Detroit River, has resigned, and the duties of the office will be performed by the Manager of the Grand Trunk at Montreal.

Chicago Great Western.—Mr. A. D. Ward has been appointed Purchasing Agent, with headquarters at St. Paul, Minn., vice Mr. J Warwick, resigned.

Cleveland, Cincinnati, Chicago & St. Louis—Second Vice President Oscar G. Murray has resigned.

Delaware & Hudson Canal.—John H. Orchard has been appointed Master Car Builder of the Pennsylvania Division and the Gravity Railroad, with headquarters at Carbondale, Pa., vice Thomas Orchard, deceased

Denver & Rio Grande.—Mr T. R. Foster, formerly on the Chicago, Burlington & Quincy Railroad, at Galesburg, has accepted the position of Mechanical Engineer on the Denver & Rio Grande, at Denver, Colo.

Duluth, Missabe & Northern.—General Manager D. M Philbin has resigned

Hannibal & St. Joseph N. J. Paradise, Master Mechanic at Hannibal, died Jan. 27. He was also Master Mechanic of the St Louis, Keokuk & Northwestern.

Hot Springs.—President E. M. Dickey has resigned.

Houston, East & West Texas.—President E S Jamison died last month.

Kansas City, Pittsburg & Gulf.—Mr. T. C. Sherwood has been appointed General Manager, with office at Kansas City, Mo.

Michoacan & Pacific.—The office of general manager has been abolished

New York Central & Hudson River.—Mr. E. C. Riser, Master Mechanic at Utica, has resigned.

New York, Lake Erie & Western Mr George Donahue, formerly Master Mechanic at Cleveland, has been transferred to Meadville, Pa. Mr Willard Kells has been made Master Mechanic at Cleveland, O.

Ohio River—The office of President is made vacant by the decease of Col. W P Thompson.

Oregon Railway & Navigation Company.—Mr. F. G. Wheeler is Purchasing Agent, with office at Portland, Ore.

Philadelphia, Reading & New England.—Mr W. J Martin has been appointed General Manager, vice Mr. C M. Lawler, resigned.

Pike's Peak.—C W. Sells has been appointed Manager.

Plant System.—Mr. W. J McLean has been appointed Master Mechanic of the Third Division, with headquarters at Montgomery, Ala.

San Antonio & Gulf Shore—Mr Wm. Davis has resigned the position of President.

Seaboard Air Line.—Mr. John H. Winder has resigned the position of General Manager and the duties of the office will hereafter be performed by the Vice President.

Southern.—Mr W. H. Thomas has been appointed Superintendent of Motive Power, vice Mr R. D. Wade, resigned. Mr. C. H. Hudson, Chief Engineer, has been made Mechanical Engineer also, with advisory duties in connection with the mechanical department. Mr. W. H. Young has been made Master Mechanic of the Charlotte Harbor division, with headquarters at Sanford, Fla.

South Haven & Eastern Railway.—Mr M V. Meridith was appointed General Manager, Feb 1.

Wheeling & Lake Erie.—General Manager Albert G. Blair has also been chosen President. Mr. W. R Setchell has been appointed Master Mechanic at Norwalk, O., vice Mr. O. P. Dunbar

Employment.

A young progressive Master Car Builder with large experience in designing and building cars is open for an engagement as Master Car Builder or assistant to same, either in railroad shops or private car line Address "NEW CARS," care of AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL.

AMERICAN ENGINEER
CAR BUILDER AND RAILROAD JOURNAL.

APRIL, 1896.

CONTENTS.

The Detroit & Mackinaw road will soon order freight cars.

The Lima Northern road in Ohio will soon contract for 12 engines.

The Toledo & Ohio Central Railroad is in the market for freight cars.

The Southern Railway will locate repair shops at Salisbury, North Carolina.

The Lehigh Valley Railroad has issued specifications for and invited bids on 2,000 coal cars.

The Delaware, Lackawanna & Western has ordered ten standard coaches from the Pullman Company.

The Ohio River road of West Virginia will shortly give out contracts for building four new passenger coaches.

The Chattanooga Southern road will immediately order 50 cars to be ready for delivery during April.

The Canadian Pacific is said to have issued specifications recently for building a number of new engines.

The Seattle, Lake Shore & Eastern road will have 120 cars built at the shops of the Oregon Improvement Co.

The Baldwin Locomotive Works has recently received orders for locomotives for two South American railways.

The Mexican National Railway has placed an order for 10 locomotives with the Rhode Island Locomotive Works.

The Wabash Railroad has placed an order for 500 box cars with the Madison Car Company. The order may be increased to 1,000.

The Choctaw, Oklahoma & Gulf Railroad will build shops at Shawnee, O. T., the citizens of that place having contributed $30,000.

The Chicago Great Western has placed orders for six coaches and two combination cars, each 55 ft. long, with the Pullman Company.

According to the *Locomotive* the number of boiler explosions in the United States during 1895 was 355, in which 374 persons were killed and 519 injured.

The Pennsylvania Railroad has placed an order for 300 coal cars with the Ohio Falls Car Manufacturing Company and 100 with the Mount Vernon Car Company.

The Wheeling and Lake Erie has placed an order for 500 cars with the United States Car Co., and 300 with the Madison Car Co. The order was erroneously reported last month as going to another concern.

The bridge across the Missouri River at Jefferson City, Mo., is practically complete, and it is said the Chicago & Alton and the Missouri, Kansas & Texas will both build short connections that will enable them to use it.

The barbette armor plates recently finished by the Carnegie Steel Co., for the U. S. battleship *Iowa* are so heavy as to require a separate car for the transportation of each plate. The weight of each piece of armor is about 48 ons.

The receivers of the Baltimore & Ohio Railroad have issued an order placing all of the shops on 10 instead of 8 hours time. This order affects about 4,500 men. It will enable the company to improve the condition of its rolling stock.

The Calumet & Blue Island Railway has given an order for 300 cars to the Haskell & Barker Car Company. The cars will have Fox trucks, Westinghouse brakes, Tower couplers, Griffin wheels, Damascus bronze bearings and Chicago roofs.

The Philadelphia & Reading Railroad contracted last month for 1,000 King hopper gondola cars, the order being equally divided between the Union Car Works and the Lebanon Manufacturing Company. The road contemplates ordering 1,500 more cars.

The Buffalo & St. Mary's River Railroad has ordered two 20 by 26-inch consolidation engines from the Brooks Locomotive Works. The same company has received an order for two 10-wheeled passenger engines and one mastodon freight engine, with 21 by 26-inch cylinders, for the Adirondack & St. Lawrence.

The East & West Railway of Alabama, has placed an order for 50 box and coal cars with the United States Car Company. The cars will be built at the Anniston shops. The same car company has contracted to rebuild 250 stock cars for the American Live Stock Transportation Company at its Hegewisch shops.

On March 11 the boiler of engine No. 4 on the Delaware, Susquehanna & Schuylkill Railroad blew up near Gum Run, killing four men and badly injuring a fifth. The engine was hauling a train of empties and was in motion at the time of the explosion. The boiler was nearly new and was supposed to be perfectly sound. The exact cause of the accident is not known.

The Seaboard Air Line has ordered several engines from the Richmond Locomotive Works. It is now in the market for 15 heavy freight engines. It will build 300 box cars immediately. Half of these cars to be built at the company's shops at Portsmouth, Va., and the remaining 150 to be contracted for. Later on in the year a further order for 1,000 cars may be given out by the company.

The Northwestern Elevated Railroad, the fourth elevated line in Chicago, has one mile of four track superstructure completed and the steel for a large part of the remainder of the road is on the ground. It is expected that the work of erecting it will proceed at the rate of a block per day, and that the line will be completed by January, 1897. The construction company has thus far spent $3,591,528.

The citizens of Tyler, Texas, have subscribed $10,000 toward a fund of $12,000, which, if raised, will be applied to the purchase of 40 acres of land on which the St. Louis, Southwestern and Tyler Southwestern Railways will extend their yard and shop facilities, they agreeing, in consideration of the contribution of $12,000 by the city of Tyler, to spend $40,000 in the extension and enlargement of their shops.

The Baldwin Locomotive Works and the Westinghouse Electric and Manufacturing Company have completed a 200 horse power electric mine locomotive for the Crozer Coal & Coke Company, to be used in the mines at Elkhorn, W. Va. This locomotive is from entirely new designs, and has features that it is expected will make it attractive to mine owners. All of the parts are carefully fitted together and are made of the best material. The weight of the locomotive is about 42,000 pounds.

It is stated, on apparently good authority, that upon the completion of the coast line to Los Angeles, the Southern Pacific will make it a portion of the main line between San Francisco and New Orleans, and will then build large shops just outside of the city and on the same side of the bay. The Oakland shops will then be moved to the new site. The new shops will be very large, perhaps rivaling those of Sacramento. It is not the purpose however, to lessen the importance of the latter plant, but rather to put all of the increased shop capacity required into the new and modern plant.

The largest vessel ever built on the great lakes was launched last month, at the shipyards of the Globe Iron Works, Cleveland. The new steamer is being constructed for the Mutual Transportation Company of that city. Its measurements are: Length over all, 432 feet, 48-foot beam and 28-foot depth. Its net tonnage on an 18-foot draught is 6,700 tons of ore or 200,000 bushels of wheat. With a 14-foot draught it will carry 4,500 tons of ore. It was built in anticipation of a 20-foot channel. The engines are of the inverted cyclinder triple expansion type, with cylinders 23, 39 and 63 by 42 inches. She will have four Scotch boilers 11½ feet in diameter by 10 ft. in length.

The Concord & Montreal Railroad will build new shops at Concord, N. H., at a cost of $300,000. The ground occupied will consist of 28 acres. Five acres will be covered with buildings, which will extend along the main track for about 4,000 feet. The plans include boiler and erecting shops, 410 by 70 feet; two machine shops, 305 by 305 feet; blacksmith shop, 60 by 150 feet; storehouse and office building, 150 by 40 feet; lumber shed, 300 by 400 feet; dry kiln, 75 by 25 feet; wood-working shop, 300 by 60 feet; boiler and engine house, 85 by 60 feet; pattern, cabinet and tin shop, 200 by 40 feet; passenger repair shop, 163 by 170 feet; freight repair shop, 162 by 170 feet, and a paint shop, 238 by 50 feet.

The annual report of the Illinois Steel Company for the year 1895 illustrates the improved condition of the iron and steel business, particularly when compared with the reports of the same company in 1893 and 1894. For the year 1893 there was a deficit of $349,472, in 1894 the earnings were only $30,607, but in 1895 the profits were sufficient to warrant the announcement of a quarterly dividend of 1¼ per cent. payable April 1, of this year. The following comparative statement for the three years is striking:

	1893.	1894.	1895.
Tons raw material received	1,283,428	1,339,570	4,355,211
Tons finished product shipped	422,781	503,146	875,098
Wages and salaries paid	$3,230,885.63	$3,071,591.95	$6,533,795.81
Average number of men employed daily	4,261	5,069	10,382

The gratifying increase in men employed and materials handled is still increasing and with about 12,000 men now on the rolls the prospects are that the company can keep them all employed on full time throughout the present year.

The government of Peru has granted a concession to an American citizen, Cuthbert B. Jones, and his associates, for the construction of a railway from the coast to the district of Hualgayoc, where coal mines of great value are reported to exist. Exclusive privileges are granted for 20 years after the completion of the line, which is to be constructed in five years. A grant is made of one kilometer of public land on each side, and contiguous to the track, for every kilometer of railway, and where there is no public land so situated 200 hectares per kilometer will be located elsewhere. Mr. Jones says that some 40 coal mines in the Hualgayoc district are owned by himself and associates, which it is their chief purpose to reach with their railroads, with the view of supplying the vast demand for coal on the Pacific coast, which is now met with coals transported from remote countries. The main trunk line from the coast to Hualgayoc will have a length of about 120 miles, to which it is designed to add a branch to Chota, 18 miles, another to Cajamarca of 35 miles. It is stated that the route presents no engineering difficulties. English bituminous coal was recently sold at Callao at $15.50 (gold) per ton.

A bridge on the line of the Union Pacific at Snake River, 14 miles west of Omaha, was recently erected in a remarkably short time. According to the *Engineering Record* the bridge gang, under the superintendence of Mr. E. F. Terry, now of the Terry & Trench Construction Company, of New York, arrived at the bridge site on the evening of Jan. 24. Work was immediately begun on the traveler and falsework for the three west spans, each of 217 feet center to center of end piers. The three spans were erected, floor system in, and ties and guard rails finished on Feb. 8, making a total of 12 working days in which the entire work was done of putting in falsework, removing the old Howe truss spans, and erecting 660 feet of new bridge. The spans are of the design known as the Pegram truss, which is patented by Mr. Geo. H. Pegram, Chief Engineer of the Union Pacific system. The last span was erected in five hours and 20 minutes. The work comprised in the erection means taking the iron from the yard, raising the trusses, and driving all pins, but does not include putting in the floor system. The floor system was changed in this span in four hours. On this work there were directly employed 70 men, and on the traveler there were 28 men and one six-spool hoisting engine. Mr. J. C. O'Melvey is division engineer.

On March 9 President Roberts, of the Pennsylvania Railroad, and a large number of officials and several invited guests, inspected the company's new bridge over the Delaware, which crosses the river at a point about five and one-half miles above the Market street ferry in Philadelphia. This bridge has been constructed to avoid the ferry over the river at Philadelphia, heretofore used for the transportation of both passengers and freight arriving at that city and destined for New Jersey points. The bridge comprises three Pratt truss spans each 540 feet long, and one draw span 330 feet long, making the total length of the bridge proper 1,950 feet. On the Pennsylvania side there is a steel trestle approach 2,200 feet long, and on the New Jersey side one 320 feet long, so that the total length of the metallic structure is 4,470 feet. There is also some wooden trestle work which is to be filled in as soon as possible. The bridge is 50 feet above high water. Besides the great length of the individual spans and the whole structure the work is remarkable for the dispatch with which it was executed. Ground was broken March 13, 1895, and the bridge was inspected March 9, 1896. At that time one track only was laid, and work was progressing on the second one. The great bridge was thus completed in almost exactly one year. It has cost over one million dollars. As soon as traffic arrangements can be completed many of the passenger trains from Atlantic City, Cape May and other New Jersey points will enter Broad street station instead of Camden, thus giving travelers from out-of-town points and the West a direct route to the seashore, besides being a convenience to many people in New Jersey doing business in Philadelphia.

Communications.

Large versus Small Grates.

Editor American Engineer, Car Builder and Railroad Journal:

Referring to your discussion of the relative merits of large and small locomotive grate surfaces, the most usual type of passenger engine, I believe, has a firebox limited to about 2 feet 10 inches wide by the frame, and is, say, 6 feet long, giving 17 feet of grate. If it were possible to widen the firebox without interfering with its other dimensions a great economy in fuel ought to be effected. However, to get more width it is necessary to place the firebox on top of the frames. Outside of mechanical considerations, the effect of this is to put the grate near the level of the door, cold air can rush straight for the tubes, the distances the gases have to pass through in reaching the tubes is lessened, and in addition no brick arch is admissible. In spite of these facts, there is probably a substantial saving to be had by increasing the grate surface in this manner when consumption is over 130 pounds of coal per foot per hour. This refers to a first-class coal, consisting almost entirely of lumps.

The following figures are instructive. Test No. 1 is the evaporation of a certain coal under a stationary boiler where the consumption per square foot of grate was low. The other figures are taken from tests of the same coal made on a locomotive at different times on the same run, but hauling heavier trains when the last test was made.

	Test No. 1.	No. 2.	No. 3.	No. 4.
Pounds of coal per hour per square foot of grate	..	82.00	87.1	140.
Equivalent evaporation from and at 212 degrees Fahr..	6.9 lbs.	6.32 lbs.	6.41 lbs.	5.50 lbs

The engine used was an 18 inch by 24 inch and had 16.87 feet of grate surface. The figures show a decided drop in the evaporation when the higher consumption of 140 pounds of coal was reached. This was not a superior quality of coal, as is evident by the figures, and it had a large proportion of slack or fine coal.

To take a more striking case. Referring to comparative tests of two compound and one simple engine. One compound and the simple engine had about 30 feet of grate, the other compound engine had a deep firebox between the frames of only about 16½ feet of surface. The two engines with large fireboxes give evaporations ranging from 7.87 to 8.05, with consumption of about 90 pounds of coal per square foot of grate. With 114 pounds consumption the small firebox engine gave an evaporation of 6.50 pounds of water. With 130 pounds consumption it gave only an evaporation of 6.1.

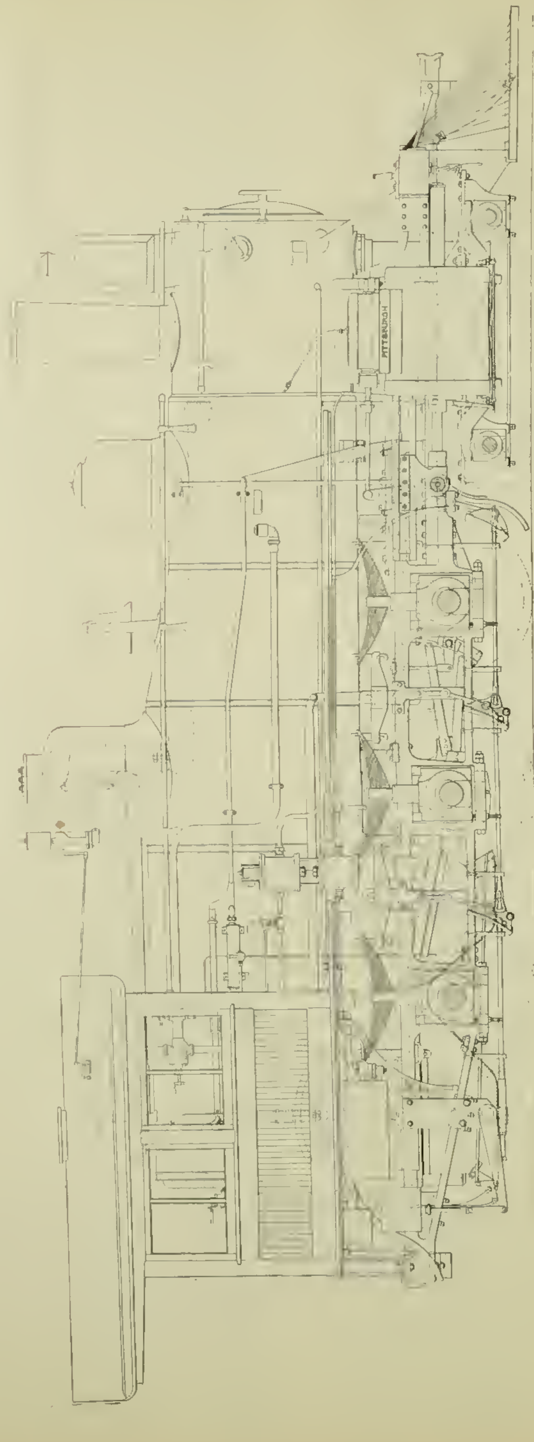
All of the tests referred to were averages of from four to six round trips over the same route and were made with care.

I. H. SCOTT.

[Our correspondent's data and deductions, it seems to us, are hardly conclusive with reference to the relative merits of large and small fire grates. He does not give the amount of heating surface in the different boilers tested. Probably the difference in the results which he reports is due more to the difference in the ratio of heating surface to the rate of combustion per square foot of grate per hour than to the difference in the size of the grates. A locomotive with 18 by 24 inch cylinders would or should have about 1,600 square feet of heating surface. When it is burning coal at the rate of 82 pounds per square foot of grate per hour the ratio of heating surface per pound of coal burned is about 20:1; when burning 140 pounds per hour the ratio is less than 12:1. More than 40 years ago D. K. Clark showed that the greater the amount of heating surface in a locomotive boiler in proportion to the work done the greater the economy, and he also indicated that the smaller the grate for a given rate of combustion—provided the coal could be burned—the more economical the engine would be. If, instead of experimenting with different rates of combustion our correspondent had taken an engine with a large grate and had made his tests with different rates of combustion with the whole grate open; then if he had covered part of it, say a fifth, with fire-brick and repeated his tests, and thus successfully covered two-fifths, three-fifths and four-fifths, each time repeating the tests with different rates of coal consumption, he would then have had the same heating surface all the time and he would have been able to compare the economy of different rates of combustion with varying proportions of grate. Such an experiment would be well worth trying, and probably the information thus revealed would be worth many times the cost of making the tests.—EDITOR AMERICAN ENGINEER.]

Ten-Wheeled Compound Freight Locomotive for the Vandalia Line.—Built by the Pittsburg Locomotive Works.

The accompanying engraving is a side elevation of one of the ten-wheeled compound freight engines which the Pittsburg Locomotive Works recently built for the Vandalia Line for use on its Terre Haute and Peoria Division. The engine has the usual features of the Pittsburg system of compounding, which have already been described in these columns. One feature of this system is the independent exhaust from the high-pressure cylinder and the consequent ability to work the engine simple at slow speeds with greatly increased tractive power. This is an advantage that is being appreciated, particularly on divisions of roads having heavy grades, as it permits the engine to take a heavier load over the limiting grade of the



TEN-WHEELED COMPOUND FREIGHT LOCOMOTIVE FOR THE VANDALIA LINE—BUILT BY PITTSBURCH LOCOMOTIVE WORKS.

division, a load which usually can be easily handled on the remainder of the division.

The engine has an extended wagon-top boiler, with a firebox between the frames, and the crown sheet supported by radial stays. The following are the leading particulars of the engine:

Fuel	Bituminous coal.
Gage of track	4 ft. 9 in.
Total weight of engine in working order	127,000 lbs.
Total weight on driving wheels	101,100 lbs.
Driving wheels base of engine	11 ft. 0 in.
Total " " " "	21 ft. 8 in.
" " " " " and tender	49 ft. 9½ in.
Height from rail to top of stack	14 ft. 7¼ in.
Cylinders, high pressure, diameter and stroke	19 in. × 26 in.
" Low " " " "	29 in. × 26 in.
Slide valves	Balanced.
Piston rods	Steel, 3½ in. diam.
Type of boiler	Extended wagon top.
Diameter of boiler at smallest ring	60 in.
" " " " back head	69 in.
Crown sheet supported by radial stays.	
Stay bolts, 1 in., hollow stay bolts, spaced 4 in. from center to center	
Number of tubes	256.
Diameter of tubes	2 in.
Length of tubes over tube sheets	12 ft. 5 in.
" " firebox inside	108 ft.
Width " "	32¾ in.
Working pressure	180 lbs.
Kind of grates	Cast iron, rocking
Heating surface in tubes	1653.0 sq. ft.
" " " firebox	152.0 sq. ft.
Total heating surface	1805.0 sq. ft.
Grate area	21.0 sq. ft.
Diameter of driving wheels outside of tire	66 in.
" and length of journals	8 in. × 9 in.
" of truck wheels	28 in.
" and length of journals	5 in. × 10 in.
" of tender wheels	33 in.
Type of tank	Level top.
Water capacity	4,000 U. S. gallons.
Fuel capacity	300 cu. ft.
Weight of tender with fuel and water	78,700 lbs.
Type of brakes	Westinghouse American Automatic.

Piece Work in Car Shops.*

G. L. POTTER.

The manufacturing and repairing of the parts of locomotives under the piece-work system had been practiced a number of years before the system was applied to car work, especially to the repairing of cars. This was due probably to the fact that the amount of money expended on locomotive work is so great per unit; that is, per engine built or repaired, and the labor such a large percentage of the total cost; in new work being about 45 per cent. and in repair work from 65 to 70 per cent., while the cost of labor in building new cars is only from 12 to 15 per cent. of the total cost, and in repairs from 45 to 50 per cent. It is also due to the fact that, on account of the much longer time required to perform the different operations on locomotive than on car work, it is much easier to determine the prices that should be paid, and with much less danger of error.

This trouble in determining the prices to be paid is not so great in building new as in repairing old cars. In new work it is customary in some cases to place prices on the body complete with all the trimmings; *i. e.*, doors, grain doors, air-brakes, etc., applied, in other cases the work is divided up and given out to different gangs of men, one gang constructing the foundation, another laying the floor, another putting up the upper structure, another putting on the sheating, another the roof, etc., so that it requires from one half to a day and a half in the first case, and an hour to five hours in the second, to complete the different operations; consequently the amount of time that should be required is comparatively easy to determine. This is also the case in manufacturing the parts for new work. While each piece can be manufactured in a comparatively short time, they are usually gotten out in large quantities, so that the time required to produce each piece is readily determined.

In repair work the conditions are different. Different cars will require different parts to be repaired, so that it is necessary to establish a price for removing and replacing and repairing each part. The difference in time required to remove the corresponding parts on different cars (even though they be of the same design), and the difference in the time required by different men to perform the same work, and the getting out of the parts in small numbers, are the main difficulties encountered in arriving at prices that are fair to both employer and employee. This can be accomplished only by thorough and careful investigation, extending over considerable time and averaging as many performances of the different operations as possible. When the work has been carried through to a successful issue, the results will well repay for the labor expended.

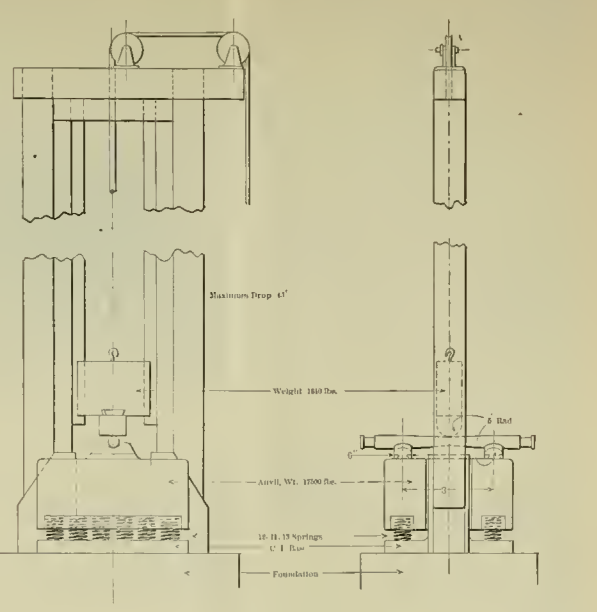
The benefits of the piece work system accrue not only to the employer, but also to the employee; to the former in that he pays for the work performed only what it has been found to be worth, can more easily locate and weed out the incompetent workman, and, with given facilities, will materially increase the output of the plant, to the latter in that he is paid for what he actually does and by increased exertion can increase his earnings, and the more competent workman is enabled to reap the benefits of his greater earning capacity.

There is probably more supervision required under the piece work than under the day work system, in the first place to see that only such parts that actually require it are repaired. There is a great tendency on the part of workmen to renew more parts than are actually necessary, especially if by doing so the earnings can be increased. To provide against this it is customary to have the car thoroughly examined before being taken into the shop, by a competent inspector, who notes on a blank the work to be done, and only such work as is so noted is allowed to be done without permission of the foreman in charge. In the second place the cars should be carefully inspected after completion, to see that all the work called for on the blank has been done and done in a proper manner, the inspector checking the items called for on the blank upon which the parts to be repaired have been entered against the parts repaired on the car. In the third place, there is danger of material being wasted by unscrupulous workmen, especially if parts can be removed more quickly and easily by destroying them. This is particularly the case in truck work, where it is easier to break the bolt off than to take off the nuts.

In starting the piece-work system in a railroad shop, the first impression that is usually formed in the minds of the workmen is that it is a scheme to reduce wages. It is necessary, therefore, to successfully establish a system, to disabuse their minds of this idea and to have them feel that the benefits will be mutual. Failures to introduce the system successfully, where it has been undertaken, can, I think, be traced in the majority of cases to unfair dealings on the part of those in charge, by reducing the prices when it was found that by extra or unusual exertions the workmen were enabled to materially increase their earnings, thus discouraging them and causing them to look upon the scheme with suspicion.

When the piece-work system has been established on a fair and equitable basis, it will be found that the cost of the output will be very much reduced, the workmen will be enabled to increase their earnings, and there will be much less dissatisfaction among them, and a great stride in the solution of the labor problem will have been made.

* Read before the Western Railway Club in February, 1896.



Drop Testing Machine with Spring Supported Anvil—Pennsylvania Railroad.

A Spring-Supported Anvil for Drop-Testing Machines.

In drop testing machines the effect of a weight falling from a specified height is considerably modified by the weight of the anvil and the character of the foundations under it. So greatly does this influence the results obtained that couplers and other articles of manufacture which have met all tests satisfactorily under one drop have been known to fail under others having more substantial anvils or foundations. All axle or coupler drop-testing machines have until recently been constructed with anvil blocks which were not heavy enough to resist with their inertia the whole force of the blow, but had to depend more or less upon the foundations under them. The heavier the anvil the less duty the foundations were called upon to perform, but in all cases the latter had to take much of the force of the blow, and they introduced an element of doubt into the results which prevented reliable comparisons between the data obtained on different machines, or upon the same machine at different seasons of the year.

To overcome these difficulties the Pennsylvania Railroad has reconstructed its axle drop at Altoona, putting in an anvil heavy enough to meet the force of all blows with its own inertia, and supporting this anvil on springs. Through the courtesy of Mr. F. D. Casanave we present the accompanying illustration of the drop as it is now arranged. It will be seen that on top of the foundations a cast-iron base is placed that forms a seat for the 12 springs which support the anvil. This anvil is a solid block of cast iron approximately 4 feet by 5 feet by 2 feet, and weighing 17,500 pounds. The axle supports are separate pieces dovetailed into the upper face of the anvil and placed the regulation distance apart of three feet. The springs which support the anvil are each composed of two coils, the outer one being 8 inches in diameter and made from steel $1\frac{3}{16}$ inches in diameter, while the inner one is 5¼ inches in diameter and composed of $\frac{13}{16}$-inch steel. The springs are 9½ inches high when light and 5¾ inches when solid. Compressed to a height of 7 inches the total supporting power of the 12 springs is 80,000 pounds.

It will be evident that in practice this anvil always presents the same resistance to the action of the drop falling from a given height. This resistance is chiefly made up of the inertia of the mass of iron, weighing 17,500 pounds, and any movement of the anvil that may take place is against the force of the springs which support it. Constant conditions are thus obtained and the rigidity of the anvil is not altered by the freezing of the ground or other changes that are unavoidable. This is an excellent improvement and if others using the drop testing machine to test their outputs or to test materials received would employ the same construction and weight of anvil, the results obtained would always be comparable with the work done on other machines of the same design, something which cannot be said of the drops in use at present.

Wear of Tires on Passenger Engines of the New York Central for the Past Twenty Years.

Comparing the weights upon the drivers a few years ago with those in present use shows an increase in the static or dead load of some 65 per cent., while the increased speed of the trains now produces dynamic effects more than double the static loads, yet by increasing the width of the head of the rails as they were renewed and the higher standard of track maintained, the rate of the wear of tires for the heavier locomotives has not increased, but, on the contrary, decreased. In 1883, on the 65-pound rails, deep and narrow type of heads, drivers carrying 13,300 pounds ran an average of 19,400 miles for a loss of $\frac{1}{16}$ inch in thickness of the tires. This was the second type of 65-pound rails, the first one having been rolled in England and had a wider head.

In 1884 the 5 inch pioneer 80-pound rail was put in service, the head being 2$\frac{11}{16}$ inches wide. Its use was yearly extended, and by 1889 locomotives on the Hudson division made nearly one-half their mileage on the 80-pound rails. Engines then carrying 17,600 pounds per driver ran an average of 19,300 miles per loss of $\frac{1}{16}$ inch in thickness of tire.

In 1891 passenger engines on the Hudson division made their entire mileage on the 80-pound rails, while those on the Mohawk and Western divisions made about three-quarters of theirs on the same class of rails; drivers carrying 20,000 pounds ran an average of 19,400 miles per loss of one-sixteenth inch in thickness of the tire. This refers to the loss by wear and returning for future service.

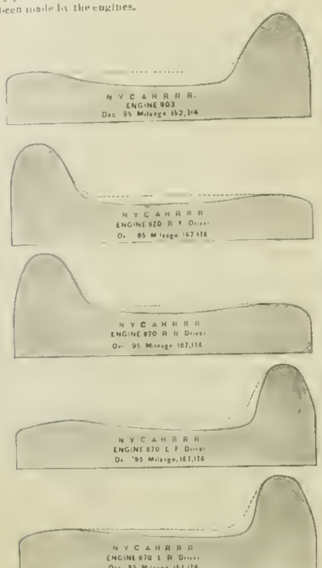
In 1892 the 100-pound rail, head 3 inches wide, was laid on the the Harlem line, which carries the combined passenger traffic of the three railroads entering and leaving Grand Central Station, New York City. The renewing of the entire line of the New York Central & Hudson River Railroad from Mott Haven Junction to Buffalo and return with 80-pound rail was completed in 1892. In 1894 the 100-pound rail was laid from Spuyten Duyvil to Peekskill, making about one-quarter of the Hudson Division laid with 100-pound rails.

In June, 1895, I asked Mr. William Buchanan, General Superintendent of Motive Power and Rolling Stock, for the mileage of some of the class "I" engines running over the 80 and 100-pound rails. When the class "I" engine was designed in 18[illegible], the weight on each driver was 20,000 pounds, but as the 80 pound rails were put into the track the weights have been increased to 22,000 pounds. The total weight of the locomotives in running service is 200,000 pounds or over 40,000 pounds being upon the truck. The mileage of the tires only includes one turning since October, 1892, and ends March, 1895. Some of the engines, of which there were 43 in all, did not enter service until 1893, and others in 1894.

The list is so large, covering such a wide range of service, that it must show conclusively whether or not a broad flat topped rail increases or decreases the rate of wear of tires running over them. The 43 engines ran 3,706,567 miles and the total loss in thickness of tires in sixteenths of an inch was 160, or an average of 23,166 miles for a loss of each $\frac{1}{16}$ inch of tire. Twenty-three of the engines which ran in part over the 100 pound rails show an average mileage of 29,046 miles for each $\frac{1}{16}$ inch loss in thickness of the tire. The mileage of 10,400 miles per loss of $\frac{1}{16}$ inch in thickness shown by the light engines on the 65-pound rails is now much exceeded by the heavier engines on the 80 pound rails the average mileage being 21,106 miles, and on the 100 pound rails it will exceed the 29,046 miles, which over one half the present engines now show by only making a part of their mileage on the wide rails.

The comparison between the wear of tires on the engines running the "Empire State Express," over the Hudson division, making one fourth of the mileage on the 100 pound rails, and the one running over the Western division exclusively on 80 pound rails is very interesting.

The engravings show the approximate wear as obtained by plaster casts after the mileage indicated; on them had been made by the engines.



Diagrams Showing Wear of Tires on Engines No. 903 and No. 870.

Engine 870 commenced the service for which the wear of the tires is shown May 25, 1894, and completed it Dec. 21, 1895. The engines are double crewed, as is customary with all, and the mileage made per month fluctuated between 8,571 and 11,200. Out of the 575 days the engine was worked 571 days, the 4 idle days being occupied in boiler washing. The total mileage in that period was 167,176 miles. During all this time the tires were not drawn except on the four idle days.

The following table shows the wear of tires with different weights on them and running on various rail sections.

No. of engine.	No. of miles run.	Circumference of drivers in feet.	Pounds of metal lost per 1,000 m. run, 4 drivers.	Rail section on which engines ran.	Weight on each driver
870	167,176	20 41	0 801	80 and 100 lb.	20,000 to 22,000 lbs.
903	152,314	22 00	1 332	80 lb. rails.	20,000 to 22,000 lbs.
84	56,219	18.06	1 234	English 65-lb. rail	15,000 to 18,000 lbs.
86	73,047	18 06	1 387	" " "	15,000 to 18,000 lbs.
4	78,864	17 28	1 379	" " "	15,000 to 18,000 lbs.

NOTE.—The 100 pound rail has a head 3 inches wide, the 80 pound rail a head 2$\frac{1}{2}$ inches wide, and the English 65-pound rail had a head 2$\frac{3}{8}$ inches wide.

The loss per yard in circumference of tire, per 1,000,000 tons rolling contract on the rails was as follows:

No. 870	0.042 lbs.
No. 903	0.070 lbs.
No. 84	0.121 lbs.
No. 86	0.136 lbs.
No. 4	0.132 lbs.

Passenger Coach With Wide Vestibules.—Lake Shore & Michigan Southern Railway.

The general dimensions of the class "I" engines are given in the following table:

Cylinder, diameter and stroke	19 × 24 in.
Steam port	18 × 1$\frac{1}{4}$ in.
Exhaust port	18 × 2$\frac{3}{4}$ in.
Bridges	1$\frac{1}{8}$ in. wide
Valves—	
Travel	5$\frac{1}{2}$ in.
Outside lap	1 in.
Inside lap	None.
Boiler—	
Diameter, smallest ring	58 in.
Pressure per square inch	170 lbs.
Firebox—	
Length, outside	105$\frac{1}{8}$ in.
Width	40$\frac{7}{8}$ in.
Area	27.3 sq. ft.
Heating surface	150.8 sq. ft.
Flues—	
Number	268
Outside diameter	2 in.
Length between sheets	11 ft. 11 in.
Heating surface	1670.7 sq. ft.
Total heating surface	1821.5 sq. ft.
Weight of engine in working order	120,000 lbs.
Weight on drivers	80,000 lbs.
Weight on trucks	40,000 lbs.
Weight, maximum tender loaded	80,000 lbs.
Tractive force per pound M. E. P.	111.07
Adhesion to tractive force	0.20
Diameter of drivers	78 in.
Driving wheel base	8 ft. 6 in.
Total wheel base of engine	22 ft. 9 in.

Engine No. 903 hauled the "Empire State Express" on the western division from April 3, 1894, to Dec. 3, 1895, total mileage 152,314. Of the four tires of engine No. 870, the left front one, was physically the softest and shows the most wear as seen in the accompanying illustrations. Both front drivers show increased wear over the rear ones from crushing the sand when first applied to the rails, and is more noticeable than on the crucible steel tires of the lighter engines of which I took plaster casts many years since. Ross Meehan shoes were applied to the drivers covering the full tread and flange of all drivers for both engines. On No. 870 considerable wear was produced on the outside of the flanges of the left side drivers, which is not included as it was not produced by the rails.

The wear of tires per 1,000,000 tons rolling contact on the rails for the amount of metal lost, as shown by plaster casts, would be influenced by many conditions which need not be considered here, yet the results point to the same general fact that by widening the top of the rail, and giving it a larger top radius, the rate is decreased, notwithstanding an increased weight is carried upon the drivers. The top radius of the pioneer 80 pound rail is 12 inches, with $\frac{5}{16}$ inch corner radii, and for the 80 pound and 100-pound rails, laid in 1892 and since, it is 14 inches, and corner radii of $\frac{5}{16}$ inch. The important point is to secure as large an area of contact between the drivers and the rails as practicable, for the larger the area is the less are the wheel pressures per square inch of contact, and the greater width of metal of both rails and wheels to resist and distribute the tractive force exerted. The tractive force of both 870 and 903 on the rails drawing the same train would be practically alike, and the difference in wear of tires mainly due to the greater average area of contact of 870, running part of its distance on the 100 pound rails, while 903 ran entirely on 80-pound rails. The mileage of either engine is very large, nearly double what is obtained on the narrow-headed rails, as will be seen by a comparison with engines Nos. 84, 86 and 4, which ran on the 65-pound rails. The practical results of introducing the broad-topped stiff rails show a decreased wear of tires, frogs, rails, ties, and expense of minimum maintenance while the speed and train loads have been largely increased. The standard freight train load of the New York Central & Hudson River Railroad, on the 80-pound rails, is 50 loaded 60,000 pound capacity cars, making a gross load of 2,250 tons, forming a train 2,000 feet long, which runs 150 miles in six to eight hours. The train load has more than doubled from the old 65-pound rails.

The broad thin type of head is making rapid progress abroad. Dr. Haarman at his Osnabruck works, Germany, has introduced several sections, while many are being rolled in England for India and Australia. My 80-pound section has recently been rolled in England for two Canadian lines.

While the thin wide head and stiff type of rails is now generally recognized as the most economical form, the pioneer 5-inch 80 pound rail met with decided opposition as being heavier and stiffer than was needed. Its introduction was largely due to the persistent efforts of Mr. J. M. Toucey then General Superintendent but now General Manager of the New York Central & Hudson River Railroad. The rail once in the track made friends and had strong advocates for the value of stiffness in a section was recognized, the principle being utilized by many railroads. It is not weight alone but stiffness as well which gives value to a section. It marked an epoch in railway progress, and while the advantages of a broad head and stiff 5-inch rail have exceeded expectations there are still greater values to be obtained by the use of the broader head and stiffer 100-pound rail.

P. H. DUDLEY,
New York.

Passenger Coach With Wide Vestibules.—Lake Shore and Michigan Southern Railway.

The Lake Shore & Michigan Southern Railway is equipping some of its first-class passenger coaches with wide vestibules, and the first one, which was recently turned out of the Cleveland shops, is illustrated in this issue. As will be noticed, the vestibule extends the full width of the car, and is provided with windows in the ends and doors extending to the bottom of the sheathing on the side. The steps are stationary and are covered with trap doors, which can be opened from the outside as well as the inside of the vestibule. Gates close the opening in the vestibule when this is at the rear end of the train. The vestibule is the Gould pattern with wide buffers.

The car is 52 feet 6 inches long over endsills and 61 feet over couplers, 9 feet wide over side sills and 14 feet 7 inches high over all. End sills and side sills are double and are reinforced by iron plates. The end of the car is strongly built, without windows and the posts are reinforced by iron bars.

The interior finish is mahogany, plainly but neatly carved. The sash is compound, allowing the lower one to be raised high enough so as not to obstruct the view when open. The deck sash is hinged at the end and is glassed with light yellow undovant glass.

The car has two saloons, located at diagonally opposite corners and at the ladies end there is a lavatory and water cooler. The car seats 62 people and the seats in the car illustrated are the Hall & Kilburn "walkover," upholstered with seal brown figured plush: the curtains are the Adams & Westlake "Acme."

The car is lighted by Pintsch gas, supplied by one reservoir, the body of the car having five 4-burner lamps and each vestibule one 2-burner lamp. The heating is by direct steam, two rows of 2-inch pipe on each side of the car being sufficient in the coldest weather.

The trucks have a wheel base of 8 feet, have 42-inch Allen paper wheels and National Hollow brake beams.

The car complete weighs about 68,000 pounds. The illustrations show the exterior of the car painted a dark color, which is the standard color of the Wagner Palace cars. The striping is in gold, plain and neat. This car with another one like it, will run on the South Western Limited between Buffalo and St. Louis.

Ten other cars are to be similarly equipped, but will be painted the standard Lake Shore yellow and will be used in through service between Buffalo and Chicago.

At the Great Northern works at Doncaster, England, there is being constructed what is probably the largest sleeping car in Great Britain. It is 66 feet 8 inches in length, 9 feet in width, and 13 feet 2 in. in height, and so fearful were the officials of its adaptability to the physical conditions of the road, that the completed framework was recently run over the line from Edinburgh to Aberdeen, in order to see whether it could successfully take the curves on the road. The trip was entirely successful, and the carriage was taken back to the shops to be completed, when it will be put into service on the east coast route. The carriage will be finished in a very elaborate manner.

Construction and Maintenance of Railway Car Equipment.—IV.

BY OSCAR ANTZ.

(Continued from Page 33.)

DRAFT GEAR CONTINUED.

The draft gear described in the last article represents in general features, the type that is most universally used in this country: in the details of the different parts there are, however, many variations from those shown and some of the most important ones will be here mentioned.

Drawbar stops differ considerably in shape and weight, but the essential part, the surface of contact of the followers is generally about that shown, viz.: 6½ inches by 2½ inches. The number of bolts which fasten the drawbar stops to the draft-timber varies from 3 to 5. Instead of two separate castings connected together by wrought iron straps, a single casting is sometimes used, which combines in one piece the two drawbar stops, chafing plate and the top and sometimes also the bottom drawbar guides. Pressed steel is also used somewhat for drawbar stops, one piece being made to answer, like the last mentioned casting, for all the attachments on the draft timber.

Steel plate is used for the draft-timber attachments by a road running out of Chicago, in the manner shown in Fig. 17. The drawbar stops, *A A*, are made of ½ by 6-inch steel plate, bent double with an eye at one end for the drawbar guide bolts, *B B*, to pass through; the followers rest against the outside of these eyes. A piece of ⅝ by 6 inch steel plate, *C C*, is placed between the two drawbar stops and the draft timber, having a projection at the center, which is let into a recess in the timber; the ends are turned up and form lugs for the drawbar stops to butt against. Seven ¾-inch bolts, three through each drawbar stop, fasten the different pieces securely to the draft timbers.

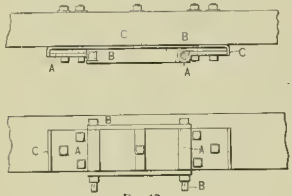


FIG. 17

Draft Gear Made of Steel Plate.

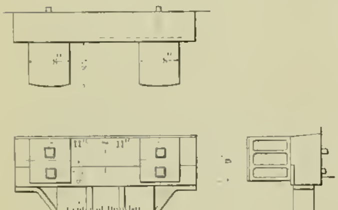


FIG. 18

Standard Location of Dead Blocks.

Follower plates vary principally in their length and thickness, the width being almost universally 6 inches. The length runs from 6 to 12 inches and the thickness from one to 1½ inches, the latter size being used more especially with the longer plates. Special shapes, not rectangular have been used somewhat, but are gradually being done away with.

Draft springs have not as a rule been made of as high a capacity as that recommended by the M. C. B. Association, the usual capacity having been 18,000 pounds, but it is very probable that 22,000 pounds will be adopted more generally in the future. To obtain a spring of such high capacity it must necessarily be made of comparatively large steel and it will therefor be very rigid under light loads. To obtain a combination which will have a high total capacity and still have considerable flexibility under light strains, some car-builders are using two springs either side by side, one over the other or one behind the other. In the latter case more than two follower plates are used and can be arranged that both springs are in action simultaneously under both pulling and buffing strains, or that only one spring is in action under light stress of either kind, and that both come into play when the load exceeds a certain amount. When the springs are placed side by side or one over the other, the follower plates have to be made longer than with single springs, but as the bearing is distributed over more surface there is less strain at one point and consequently less liability to bend the plate.

The draft springs are usually capable of being compressed about 2 inches, while the strains in the pulling of the car are seldom severe enough to compress the springs this amount, except when starting a very heavy train, a severe butting strain, such as occurs when the head end of a train is stopped suddenly and the rear end "runs up" on to it, or when switching cars, very often closes them completely, and the shocks are then transmitted directly to the draft-gear, and often with disastrous results. To avoid this, some arrangement is generally made to have the frame of the car absorb some of these shocks before the springs are entirely compressed and without transmitting them to the draft gear. The usual method of doing this, up to about the time of the introduction of the automatic coupler, was by the use of bumpers or deadwoods on the endsill or face-block, which were of such dimensions that when two similarly equipped cars were coupled together the bumpers or buffers would come in contact with each other before the draft-springs were closed, and being in line with the sills of the cars there would be substantially a continuous framework, at least as far as these two cars were concerned, relieving the draft-gear of further strain.

These buffers are usually made of cast iron, but wood faced with plate iron is also used by some roads. At first there was considerable variation in these bumpers on the different roads, which created more or less trouble, and to bring about some uniformity the M. C. B. Association recommended a standard for size and location of deadwoods for cars with link and pin drawbars, and later also one for cars with the M. C. B. drawbars; the latter is shown in Fig. 18.

These deadwoods are not in great favor as they are liable to cause injuries to the trainmen when making couplings, at least with the link and pin drawbars, with the automatic coupler this objection does not appear to be so serious, but as the buffers are of no account whatever when only one of two cars coupled together is provided with them, their use seems to be gradually dying out, and the coupler itself is provided with a means of attaining the same result. A projection or horn, *J J*, Figs. 15, 16, 22 and 23, is cast on the top of the coupler head, which acts in the capacity of a stop when the draft spring is compressed a certain amount; the M. C. B. Association has adopted 1⅝ inches as this amount, and the coupler is therefore placed in such relation that there is 1⅝ inches between the horn and the end sill or face block, when there is no strain on the spring.

While the horn on the drawbar does not present as large a surface of contact as buffers, and the strain is not removed from the head of the coupler itself, there is, however, the advantage that each car with a coupler so provided, is complete in itself, and is not dependent on its neighbor for proper action of the draft gear.

The faceblocks on the endsill vary considerably on different roads in all three dimensions, the latter being determined somewhat by other attachments on the endsill. The protecting or striking plate on the faceblock is often made of angle-iron, one side of which is placed on the lower side of the block and prevents the top of the drawbar from wearing into the block.

The carry-iron under the faceblock often ends at the sides of the draft-timbers, and sometimes is extended on one side horizontally and is drilled to take the lower end of the brake-staff. The draft-timber guards vary according to the distance between the timbers, in order to maintain the standard distance of 5¼ inches between the castings: sometimes they are omitted entirely.

With the rectangular follower plates, which have a bearing on the ends, the strain at the center is considerable and they frequently bend and break at this point. To avoid this, a number of draft gears have been designed, which use, instead of rectangular plates, thimbles of cylindrical form provided with collars bearing on the draw bar stops, which extend across between the draft timbers and are provided with a hole in which these thimbles work, and against the edge of which the shoulders on the thimbles strike.

One of these draft gears, which is used extensively, and more especially on Southern roads, is illustrated in Figs. 19 to 23. The general arrangement of parts as shown is made to agree as nearly as possible with the plan recommended by the M. C. B. Association and the special features are adapted to them.

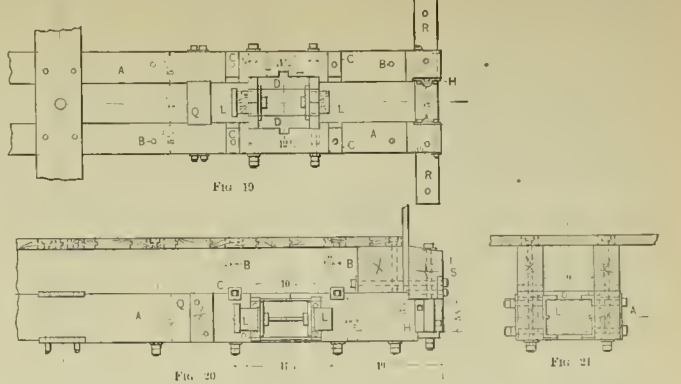


FIG. 19 FIG. 20 FIG. 21

Draft Gear with Thimbles and Spring Case.

The draft timbers *A A*, which are fastened to the sills of the car by the bolts *B B* and are further secured from shifting by the cast-iron blocks *C C*, are notched out on the inner side for the spring case *D D*. This is a malleable casting, made of two parts, bolted together and to the draft timbers by four ¾ inch bolts, provided with lock-nuts and having large washers under heads and nuts. Each half of this casting is made in skeleton form, the center being large enough to receive the draft springs and the flanged ends cored out round to guide the malleable follower thimbles *L L*; these have collars cast on them, forming a stop against the inside of the spring case, and lugs on these collars hold the draft-springs in place. The front thimble bears against the rear end of the drawbar, as shown in Figs. 22 and 23; the back thimble is provided with another collar, which bears against the drawbar pocket *O* or the tailpin key *U*.

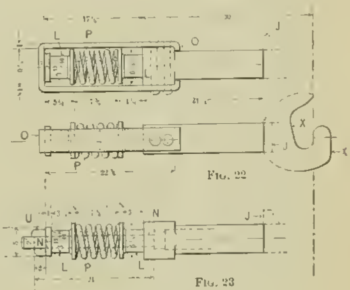


FIG. 22 FIG. 23

Draft Gear with Thimbles.

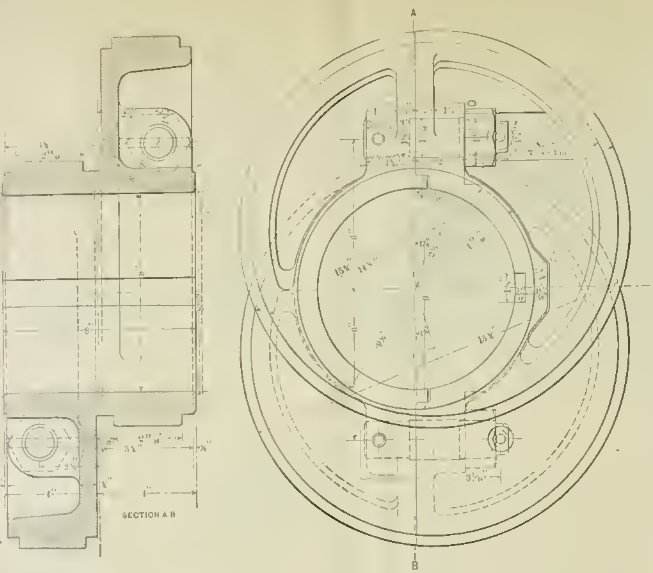
The draft timbers are tied together by the four ¾-inch bolts through the spring case, and by two ⅞-inch bolts passing through the distance piece *Q*. Other ties of wrought iron are sometimes placed below the draft timbers, but these are hardly necessary when the six bolts are used as shown.

The front arrangement of carry-iron *R*, face block *I*, draft timber guards *H* and face plate *S*, can be made similar to that shown in the previous article, due allowance being made for the different spacing of the draft timbers.

The connection to the rear end of drawbar can be made by means of the pocket *O* or the tailpin *N*, either of which must be made longer than with the rectangular follower plates. When the tailpin is used, the lugs on the inside of follower thimbles are omitted, as the pin forms a guide for the draft springs, and the block *Q* must be moved nearer to the body bolster to clear the end of the tailpin.

(To be continued.)

The Long coal unloading machine erected on the N. Y. P. & O. coal dock at Cleveland unloaded over 1,000 cars of coal between Sept. 17 and Feb. 1, 1896, notwithstanding the fact that it has stood idle more than one-half of the time waiting for cars and boats. This machine consists of a cylinder which receives the car within it and then rolls it over bodily, dumping its contents into chutes that lead to the hold of the vessel being loaded. Future machines will be so constructed that only two men will be needed to operate them.



Double Eccentric for "Class R" Locomotives—Pennsylvania Railroad.

Double Eccentrics for Class R Locomotives on the Pennsylvania Railroad.

In the accompanying illustration we present the drawing of a "double eccentric" inuse on Class "R" locomotives on the Pennsylvania Railroad. This "double eccentric," as it is called on the road, consists of two split eccentrics cast together, two castings only being required in place of the four usually employed, and the object of this method of construction is to obtain greater strength and better fastenings. The eccentrics are split at right angles to the customary line of division, and the two parts are bolted together by two studs 1¼ inches in diameter. The hub and rim of each eccentric are united by a plate or web ¾ inch thick and at the joint between the castings there is a cross web of the same thickness with a boss on it 1½ inches high for the stud. The studs are screwed into one-half and each held in place by a ⅜-inch rivet passing entirely through the stud and boss. At the other end of the stud is one nut secured by a No. 7 taper pin. A 1-inch hole in the web of the eccentric opposite the taper pin makes it accessible from either side.

After planing the joint between the two castings which make up the double eccentric, they are put together with one thickness of heavy manilla paper between them and bored for the axle fit. The paper is then removed and the eccentric clamped onto a mandril for turning. This mandril has in its ends centers correctly located for both the throw and angular advance.

The completed eccentrics are evidently adapted only for one angular advance which cannot be changed in forward gear without distorting the back gear, but on a road having so many locomotives of one class as the Pennsylvania Railroad this is no objection. Of course it would not pay to make eccentrics in this manner where the locomotives were few in number and their valve gears were not duplicates in every detail, but in the case cited it does pay, and a more substantial piece of work is obtained than is possible with the common construction. They have been used on Class "R" engines for more than a year with excellent results.

Chinese Railway Projects.

Advance sheets of consular reports for March contain a communication from the United States minister at Peking, on railroad enterprises in China, from which it appears that a decree has been issued by the Emperor, placing the construction of the railroad from Tientsin to Lu Kou Bridge, eight miles west of Peking, in the hands of Hu Chüfen, a native of Kwangsi province, holding the rank of provincial judge, and a man who has had some experience with the Tientsin railroad. The cost of the line (approximately 70 miles) is stated in the decree to be 2,400,000 taels (about $2,000,000 United States currency), or more than $25,000 per mile. An American engineer recently estimated the cost of this line at $20,000 per mile, with rolling stock and equipment complete. The proposed route presents no difficulties except the necessity of high embankments and numerous drains and culverts in certain localities to cope with annual floods. It is understood that Mr. Hu's instructions are to employ no foreign capital whatever. He is said to have already 4,000,000 taels at his command, and it is said he proposes to finish the line within a year. A part of the decree ordering merchants to form stock companies for railroad building outlines the present railroad policy of China. There is a strong determination on the part of the Government to exclude foreign capital and foreign control. There is reason to believe, however, that this determination will give way before the magnitude of the undertaking which will bring to light the inexperience of the Chinese managers. There will then be a great field open there to foreign railroad enterprise.

This field has already attracted great attention, and it will doubtless be eagerly disputed by the representatives of the railroad interests of various nationalities. United States Minister Denby has urged on the Chinese authorities the pre-eminence of the Americans in railroad construction, and in the manufacture of all those products which China's railroad system will in time require. It would be much to be regretted should this market be allowed to pass without an effort into the hands of others.

Concerning another enterprise, the *North China Herald* of Jan. 17, 1896, says: It is reported, upon what seems to be good authority, that the Liangkiang viceregal government has given the construction of the Shanghai-Soochow Railway to a cosmopolitan syndicate, at the head of which is a Belgian. The Chinese are to borrow the money for construction from the syndicate, the loan to be repaid in installments beginning from the third or fourth year after trains have commenced running between the two cities. The object of this is to make the railroad obstructionists in Peking believe that Chinese capital has been employed in the construction of the road. The terminus of this railway is to be at Sinza (Chinese territory), where also will be the freight and passenger offices of the semi-government steamboat line to run between Shanghai, Soochow and Hangchow.

Station Name Boards.

On account of the many complaints received by the British Board of Trade as to the inconvenience caused to the traveling public by the ineffective manner in which the station names are indicated at railway stations, a circular was sent out to the various railway companies of the United Kingdom asking them to state what steps they proposed to take in order to deal effectively with the subject. The replies to this circular are contained in a blue book just issued. Among the various companies whose answers are given, the Great Northern Railway Company state that they have decided, with a view to keeping the names of the station distinct from advertisements, to show the names on angular boards projecting from the station walls, and also on platform lamps, and, when practicable, waiting-room windows. The Great Western Company report that they have taken steps to provide distinctive name-plates at all new stations, and to rearrange those at existing stations (when these stations are renovated), so as to leave a space of 12 inches between the name-boards and advertisements. A standard pattern of name-board has been adopted, and the boards are fixed in prominent positions. The names are also shown on lamps and seats. The Metropolitan Company report that the names are shown at their stations on boards and platform lamps and seats, and that they have given notice that all advertisements must be removed 18 in. clear of the name-boards. They have also provided additional boards, which, to prevent confusion with advertisements, bear the word "station." The Metropolitan District Railway, after describing the way in which the names are displayed at their stations, add that they have also decided to adopt an apparatus for automatically indicating in each compartment the name of the station the train is approaching. The Caledonian Company propose to make arrangements to prevent advertisements from being placed in close proximity to the name-boards. The majority of the other companies express the opinion that their present arrangements in respect to station names are satisfactory; but a number of them add that they will be glad to consider any recommendation which may be made to them on the subject.

It would be in order if we had a national Board of Trade to make a similar inquiry in this country. The elevated railroad in New York especially should improve its signs for the use of travelers at night. The names of the stations should be inscribed in some way in the glass globes of the gas lights. It is now very difficult for a stranger, or even native New Yorkers, to tell what station "he is at" in the night.

Contributions to Practical Railroad Information.

Chemistry Applied to Railroads

SECOND SERIES—CHEMICAL METHODS.

XVII.—METHOD OF DETERMINING PROPORTIONS OF OIL, PIGMENT AND MOISTURE, OR DEFICIENCY OF HYDRATION IN FREIGHT CAR COLOR.

BY C. B. DUDLEY, CHEMIST, AND F. N. PEASE, ASSISTANT CHEMIST, OF THE PENNSYLVANIA RAILROAD.

EXPLANATORY.

The standard freight car color of the Pennsylvania Railroad Company is bought in paste form, and the paste must contain nothing but oil, pigment and moisture. The moisture and other volatile constituents must not exceed 2 per cent. of the weight of the paste, and the paste must not be a "liver" when received. The oil must be pure raw linseed oil, and must not be less than 23 nor more than 27 per cent. of the weight of the paste. In determining the proportions of oil, pigment and moisture, or other volatile constituents, the oil must be heated before weighing to 250 degrees Fahrenheit, and the pigment must be dried before weighing at from 60 to 90 degrees Fahrenheit in air which has been artificially deprived of moisture. The inert material in the pigment may be sulphate of calcium or gypsum, silica, kaolin, soapstone or asbestine, the two former preferred. Carbonate of calcium must be present to the extent of 2 per cent., but must not exceed 5 per cent. of the weight of the pigment. Ground feldspar is not desired, and barytes or sulphate of barium, organic coloring matters and caustic substances are excluded. The pigment must contain not less than 20 per cent. of sesquioxide of iron, and if sulphate of calcium or gypsum is present, it must be fully hydrated. The paste must conform to standard shade, and must pass test for fine grinding.

OPERATION.

Weigh a six-ounce Erlenmeyer flask and then introduce five grams of the paste to be examined. The manipulation of the paste is not entirely easy. It is best to weigh the material into the flask, using a narrow spatula to transfer it and taking great pains to prevent any of the paste from getting on the outside of the flask, or near the top on the inside. Fill the flask about one-third full with 38 degrees Beaume gravity gasoline, and agitate with a rotary motion in a horizontal plane, until the paste is all decomposed. Now add more gasoline and agitate in the same way to secure mixing, until the flask is about two-thirds full, and finally add gasoline from the jet of a wash bottle, so as to mix as thoroughly as possible, until the flask is nearly full. Cork loosely, without permitting the liquid to touch the cork, and allow to settle, which may require from two hours to two days. When the liquid is clear, carefully remove the cork, and decant the liquid into a tall lipless beaker, holding about nine ounces. By using sufficient care, the liquid may be decanted down so that not over five cubic centimeters are left in the flask. Some skill and a little experience are required to secure this result. Incline the flask and allow perhaps half the liquid to run out. Then if the pigment has not already collected at the lowermost point of the flask, keep the flask inclined just so the liquid will not run out, and assist the collection of the pigment at the lowermost point, by striking the flask gently against the desk. If this operation roiles the liquid near the bottom of the flask, place it still inclined in the top of a beaker or other support and allow to settle again, which usually takes only a short time. Then continue the decantation until the limit is reached. Place the beaker where the temperature is a little above the boiling point of the liquid, and where there are no naked lights and then fill the flask with gasoline again in the manner before described. Allow to settle a second time, and repeat the decantation in the same manner. Enough of the liquid in the beaker will, if the evaporation is properly managed, go off while the pigment is settling the second time to furnish room for the liquid for the second decantation. Evaporate the liquid in the beaker as before, gradually raising the temperature as the liquid will bear it, until a temperature of 250 degrees Fahrenheit is reached. Cool and weigh from time to time, and continue the heating at the same temperature until constant weight is obtained. This weight, minus the weight of the beaker, is the weight of the oil. After the second decantation add to the flask containing the pigment three or four cubic centimeters of a mixture of equal parts of ethyl alcohol and distilled water, agitate to secure thorough mixing, cork with a double perforated rubber cork carrying two tubes, one of which reaches to within an inch of the bottom, and attach the other to a steam or water aspirator, or other means of drawing air through the flask. The air drawn into the flask should not carry dirt, or injurious gases along with it. The gasoline, the alcohol and the principal portion of the added water are removed in the course of a few hours. As soon as the visible liquid has disappeared, attach to the air inlet tube an arrangement for passing the air through concentrated oil of vitriol, and continue the drying until the flask containing the pigment shows constant weight. Deduct the weight of the flask from this weight, and proceed as explained under calculations.

APPARATUS AND REAGENTS.

The flasks and beakers required are perhaps sufficiently designated above.

The arrangement for taking moisture out of the air used in drying the pigment by causing it to bubble through concentrated oil of vitriol may, perhaps, be readily improvised in every laboratory. Drechsel's wash bottles for washing gas, with ground glass joint, are very convenient for this purpose.

The gasoline specified is readily obtained in the market. It is best to obtain it in tin cans and every new shipment should be tested. If the same amount used in an analysis leaves a weighable residue, when a blank oil determination is made, a correction corresponding to this should of course be made. It is better, however, to secure such a grade of gasoline, that no residue will be left. If the gasoline is not shipped or stored in wood or dirty cans, very little difficulty will occur.

The ethyl alcohol is the ordinary 95 per cent. alcohol of the market, and the ether mentioned later is the ordinary commercial sulphuric ether of the United States Pharmacopia.

CALCULATIONS.

The weight obtained by deducting the weight of the beaker from the constant weight of the beaker and oil as above described, gives the weight of oil in 5 grammes of the paste. Let us suppose this to be 1.1865 grammes. Then the percentage of oil would be $(1.1865 \times 100 \div 5)$ 23.73. Also if the pigment in the paste were fully hydrated, the weight of the flask and pigment, minus the weight of the flask, gives the weight of the pigment in five grammes of the paste. Suppose this to be 3.7240 grammes. Then the percentage of pigment would be $(3.7240 \times 100 \div 5)$ 74.48. In this case, if no volatile constituent but moisture is present, the moisture would be $100 - (23.73 + 74.48)$ 1.79 per cent., the moisture being determined, as is seen, by difference. In case the pigment in the paste was not fully hydrated, the water added with the alcohol accomplishes this result, and the sum of the oil and pigment, provided no other volatile constituent was present, always exceeds 100 per cent., the excess representing the deficiency of hydration of the pigment, as is readily seen.

M. S. C. NOTES AND PRECAUTIONS.

It is quite apparent that this method involves as its principal features the insolubility of the pigment in gasoline, the solubility of the oil in the same menstruum, and the volatility of the gasoline without vaporizing either the oil or the pigment.

It frequently happens that samples of paste are found, the pigment of which settles very slowly. With many of these samples, the addition of 3 to 5 cubic centimeters of a mixture of equal parts of ethyl alcohol and distilled water, while decomposing the paste, facilitates the settling.

It is best to add this alcohol and water before the second addition of gasoline in order to secure thorough mixing. After a little experience is gained, the behavior of the pigment when the paste is decomposed and before the second addition of gasoline, is something of a guide as to whether the alcohol and water are needed. If the pigment shows a disposition to settle off readily on allowing the flask to stand a few minutes, the alcohol and water will probably not be needed. If there is no such disposition, it is better to add them. No harm results from the addition, and some operators prefer to always add the alcohol and water. With a very obstinate paste which settles very slowly, or indeed refuses to settle clear after considerable time, it is usually best to start afresh and use ether in place of the first addition of gasoline, and sometimes ether may be used to advantage throughout.

There is considerable evidence that the rapid settling of the pigment is a question of the hydration. During the grinding the mills usually become quite warm, and the tendency is to de-hydrate both the sulphate of calcium and the clay, both of which are almost universally present in greater or less amount in freight car color. Alcohol containing small amounts of water is slightly soluble in gasoline, and its presence, therefore, facilitates the transfer of the water to the pigment. Also commercial ether contains small amounts of water, and this is apparently transferred to the pigment in the same manner. With some paints a coagulation of the pigment in flakes, and almost immediate tendency to settle, follow the addition of the alcohol and water, or the use of the ether.

It should be stated, that, notwithstanding all precautions, it sometimes happens that some extremely fine portions of the pigment refuse to settle, even after a day or two, leaving a slight tint or opalescence in the liquid. No method is known of overcoming this difficulty, but it is believed that the error resulting does not exceed a small fraction of one per cent.

If the paste contains 25 per cent. of oil, as is desired and expected, the amount of oil in five grammes would be 1.2500 grammes. About 150 cubic centimeters of liquid is present before the first decantation, and by the supposition five one-hundred and fiftieths of this are left after the decantation is finished. That is $(1.2500 \times 5 \div 150)$ 0.0416 gramme of oil are left. But if the directions are followed, five one-hundred and fiftieths of this are left after the second decantation, that is $(0.0416 \times 5 \div 150)$ 0.0013 gramme of oil are left with the pigment and weighed with it. This amounts to an error of $(0.0013 \times 100 \div 5)$ 0.026 per cent. If greater accuracy than this is desired, a third treatment with gasoline can be employed.

The separation of the liquid from the pigment by decantation is much better than to use a siphon. Formerly a siphon was employed, but it was found that there was a little loss due to material adhering to the siphon, and also the liquid could not be drawn off so as to leave as small a volume behind, on account of the currents at the inlet end disturbing the pigment.

It is probable that there is a slight oxidation of the oil during the evaporation and subsequent drying to constant weight. Direct experiments on oil free from moisture, however, show that the change in weight due to this oxidation is very small. Mülder has shown that during exposure to the air, especially at high temperatures, linseed oil loses carbon and possibly hydrogen, while it gains oxygen, and experiments made for the purpose show that the loss and gain very nearly balance each other, so that the error introduced during the drying can safely be ignored.

The directions require that both the oil and pigment be dried until constant weight is obtained. It is probable that, especially with the oil, absolute constant weight would never be obtained. If the difference between two weighings an hour apart does not exceed one or possibly two milligrams, the resulting error will be small, as is readily seen, as to have no practical importance.

The directions to put the paste low down in the flask during the weighing, and to prevent the liquid from touching the cork, are perhaps of more importance than would appear at first sight. The difficulty of avoiding loss while decomposing the paste, if it is near the top of the flask, is quite considerable, and the loss if the liquid touches the cork is much more than would be supposed.

Gasoline is quite sensitive to changes of temperature, and its vapor tension even at ordinary temperatures is quite considerable. If the flask is tightly corked, therefore, there is danger of loss of both flask and its contents.

If the pigment is fully hydrated, the amounts of pigment, liquid and moisture, or other volatile constituents are given by the method with all the accuracy that is necessary in the analysis of such a product as freight car color. But if, as frequently happens, the pigment is not fully hydrated, it is evident that benzine, turpentine or some other volatile substance, could be added equal in amount to the lack of hydration of pigment, without this fact being revealed by the method as described. In cases where such additions are suspected, their presence or absence is determined by other tests, especially by distilling over the volatile constituents from a portion of the paste and examination of the distillate. The temptation to put volatile constituents into a paste is not very great, however, since, as stated above, owing to the heat of the mills, the loss of such volatile constituents during grinding would be quite considerable.

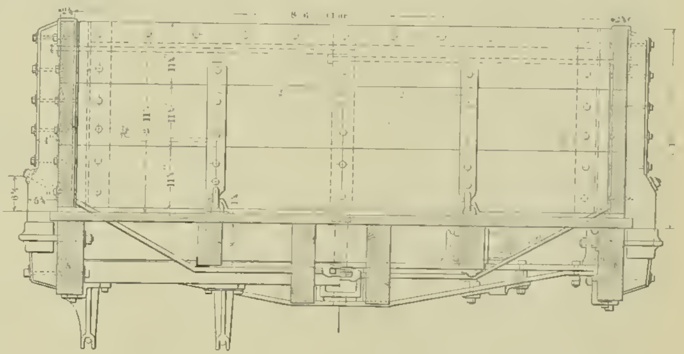
On the Halberstadt-Blankenburg Railway in Germany graphite is used successfully for lubricating the inner vertical faces of the outer rail-heads on curves. It is ground very finely and mixed with just enough water to form a thick paste, and when applied to the rails dries quickly, and the thin layers formed adhere a reasonable time to the rails. During the wet season of the year it appears that there is no necessity for lubricating the rails. Experience shows that in dry weather it is advisable that the line watchman should lubricate the rails every five days, although, doubtless, the frequency of the lubrication will depend upon the amount of traffic. On the Hartz line it is said the trains are hauled by six-wheel coupled engines, with trailing Bissel pony truck. Prior to the introduction of graphite lubrication, the tires had to be turned every four or five months. The original tire material, which was too soft, was replaced by Krupp crucible cast-steel, and, at the same time, the lubrication of the outer rails introduced. The tires now need turning only after they have been in service 18 months to two years. The same lubricant is also used on the sections of the road which are worked on the Abt system for lubricating the rack and spur wheels.

An Effective Truss for Coal Car Sides.

The trussing of coal car sides to prevent their bulging under the pressure from the load is a problem that has seldom been settled satisfactorily. It was made the subject of a report by a committee to the Master Car Builders Association in June, 1895, but the methods recommended for strengthening the sides did not appear to meet with approval, either because they were considered ineffective or because they were patented and therefore could not receive the official endorsement of the association.

In the accompanying illustration we show a method in use on the Chicago, Milwaukee & St. Paul Railway, which appears to us to be very neat and effective. We are indebted to Mr. J. N. Barr, Superintendent of Motive Power, and Mr. Geo. Gibbs, Mechanical Engineer of the road, for our drawings and information. It will be seen that the stakes are secured to the side sills in the usual fashion, but at a point about 6½ inches above the floor are provided with a beveled surface which forms the seat for a nut and washer on the end of a truss rod that passes through the stake and down under the intermediate and center sills and up to the stake on the other side. The truss rod is made three-quarters inch in diameter and is provided with a turn-buckle at the center. Saddles are provided under the intermediate sills which may be in the form of castings or simply an angle iron secured to the corner of the sill.

This construction has the advantage of not encroaching on the coal space in the car, and not being in any way attached to the side sills it counteracts the tendency of the load to push or "roll" them out, an evil which most methods do not overcome. It is simple, and has been found to be quite effective. In cars 34 feet long inside, and with sides 3 feet high, four of these trusses are employed. In addition to the trusses and the fastenings at the end boards or gates, the sides are further held by straps on the inside, bent over at the top and terminating at the bottom in bolts which pass through the side sills. These are also shown in our drawing, and form a construction well known to our readers. Those seeking a remedy for bulging sides of coal cars might do well to give the method of trussing here shown a trial.



Improved Method of Trussing Coal Car Sides—Chicago, Milwaukee & St. Paul Ry.

Convenience and Efficiency of Locomotive Design.

The following very sensible suggestions on this subject are made in an article written for the *Railway Herald*, the author of which signs himself J. H. Jenkins, Engine Driver, Swansea Dock Railway:

"The object in writing the article," he says, "is to point out that the things which are of vital importance to drivers and firemen for the proper manipulation of the machine such as the convenient position of tool boxes, sand boxes, brakes, levers, etc., are left to look after themselves Indeed, things which appear to be mere trifles to designers, are, if not convenient and efficient, 'mountains of vexation' to the men.

"Of course, we are progressing in many things; but we are too slow. It seems that once we get into a slovenly way of working, use becomes second nature, and we stay there until by mishap--sacrifice of limb, life, and property--some important change is forced upon us. As a proof of this snail-like progression, look how we bore the wet sand-box for years, notwithstanding the terrible risk. Why, it makes one shudder to think of the poor fireman out on the leading end on a dark stormy night, holding on for his life with one hand and sanding with the other; the rain on one side beating through his clothes to his very skin; the beat of the smoke-box on the other, scorching him, to say nothing of an occasional red-hot cinder which had a way of landing, with devilish precision between the collar of his coat and his neck

"With regard to tool-boxes being placed on the back of the tenders, and the number of men who are knocked off and mangled continually, it will be sufficient to observe that, like the Armenian atrocities, we are getting used to them.

"These things cast a sad reflection upon our 'big ones,' and it is to be earnestly hoped that the *Herald*, which has always cast its strong rays of light into many dark places of railwaydom, may again be the means of bringing about a speedy change in these things also.

"We now come to a matter which is of the utmost importance to enginemen, and which really is the main object of the writer—*i. e.*, the gage-glass. It has been the practice for many years, and is now to a great extent, on the London & North Western Railway, to connect the steam-gage pipe to the top cock of the gage-glass. Now the folly and disadvantage of this arrangement is apparent, even to the most superficial observer. In the event of the steam-gage failing, the gage-glass would have to be shut off too, and vice versa

"Just think for a moment of the sorry plight of the driver and fireman who, on some rough night, have all they can do to get along, a glass bursts, perhaps when entering some important junction, after a minute or so of battling with the overpowering steam and water, the cocks are shut off. Now, it is a trial in itself to have no means of ascertaining the level of the water in the boiler; but the trouble in this case is that the steam gage is now no longer in communication with the boiler; consequently they have to get along without both, or until an opportunity occurs on the road to put one in. True, there are try cocks, but these are usually such paltry things that they often get neglected. Then, again, the automatic cocks which are fitted to many of this company's engines, though independent of the steam-gage, are not efficient; in fact, there are many instances where trains have had to be given up through these cocks failing

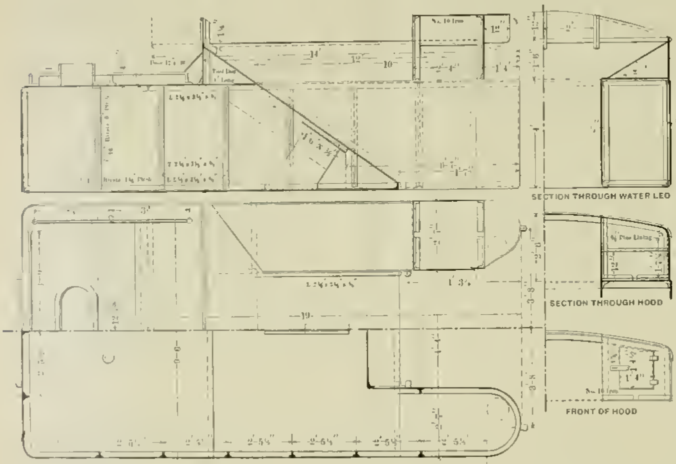
"In my humble opinion, all boilers should be fitted with two automatic gage-glasses, independent of the steam gage, and so constructed that, in the case of failure, they could be shut off by hand. I have used them, and speak from experience, and can testify to the convenience and efficiency of such an arrangement."

Locomotive Tank with Sloping Coal Space—Chicago, Burlington & Quincy Railroad.

The Chicago, Burlington & Quincy Railroad put in service some months ago several locomotive tanks so designed that all the coal carried would come down within reach of the fireman by the action of gravity. Our illustrations show the construction clearly The coal space has a sloping back which extends to a point 18 inches above the top of the tank and 24 inches back of the junction of the slope sheet with the top plate. No coal is carried on top of the tank back of upper termination of this slope. The tank is provided with a hood which extends 3 feet 8 inches back from the front ends of the water-legs, and back of the hood there are sloping sheets riveted to the inside top edge of the legs and to vertical extensions of the side sheets. Thus all coal carried over the water-legs will slide down into the coal space as the latter is partially emptied.

Back of the coal space the tank is perfectly plain, with no "dickey" The manhole is placed well back, and grabirons are placed across the back and along the sides. The hood contains good tool boxes over each water-leg, and the triangular space between the back slope sheet and the top of the tank is also utilized for a tool box four feet long, and with a door 12 inches by 30 inches, accessible from the top of the tank, as shown.

The sides and back of the tank are braced with tee-iron. The slope sheet is substantially supported No dashers are used, and they have not been found necessary. The tank is 19 feet long, 9 feet 6 inches wide, and 4 feet high. The coal space is 4 feet 4 inches wide, and 18 inches higher than the rest of the tank. These tanks have been built in two sizes, the second of which is shown in dotted lines. As shown in full lines they hold 4,300 gallons of water and seven tons of coal. With the enlarged coal space the water capacity is 4,010 gallons and 8¼ tons of coal. The tanks have a very neat appearance.



Locomotive Tank with Sloping Bottom to Coal Space—Chicago, Burlington & Quincy R. R.

Protection of Water Gage Glasses.

Mr. F. W. Webb, of the London & North-Western Railway, proposes the use of a spiral wire spring encircling glass tubes, as shown in the engraving in Fig. 1 as a protection to men from the breaking of such tubes. The spring forms a good support or backing to the glass, and when breakage occurs holds the pieces together and prevents them scattering. It is also claimed that the spring maintains the glass at a more uniform temperature. In the event of fracture the glass is easily removed by slightly compressing the wire spring, which can then be removed from the recesses in which it fits at the ends.

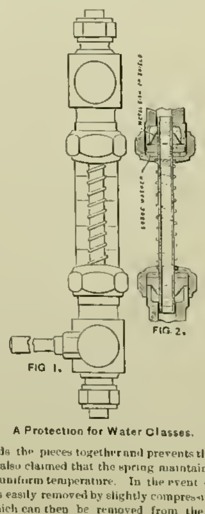


FIG 1. FIG. 2.

A Protection for Water Classes.

Mr. Webb also refers to another little improvement in the packing for the glass and which consists of a conical brass shield, now commonly used for high-pressure gage glasses. This ring is flanged on the outside so as to rest on the top of the gage glass fitting, and prevents the india-rubber getting out of shape (see Fig. 2). This Mr. Webb states, results in the conical packings lasting very much longer, and also gets rid of a good deal of trouble which was previously experienced with the india-rubber rings before they were protected.

Comparison of Mechanical Draughts.

FROM A PAPER READ BEFORE THE INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND, BY MR. JOHN THOM, M. I. N. A.

I have been led to choose this subject through having crossed the Atlantic three times in an official capacity, and each time in a vessel fitted with a different arrangement of mechanical draught.

My intention is to mention the results obtained from the arrangements adopted in these vessels and other systems that have come under my own supervision, and it will be instructive if other members will give their experience with any other arrangements.

The systems I took notes from were:

First.—The closed stoke-hole, usual Admiralty system, gratings covered over and air forced into the stoke-hole with fans, and air-locks for allowing men to enter and go out.

Second.—The well-known Howden system of forced draught, with the air heated on the way to the furnaces by the hot gases as they pass to the funnel.

Third.—The Ellis and Eaves arrangement of induced draught, with the air heated on the way to the furnaces, similar to Howden's system, but the fans in this instance are placed at the base of the funnel, and induce the gases to them (will be spoken of as suction draught in this paper).

Fourth.—The closed ash-pit arrangement, with fans discharging direct to the furnaces, and stoke-hole gratings open.

A. The first arrangement mentioned, the closed stoke-hole, is still working satisfactorily after many years' use, and does not appear to injure the boilers as it is worked. The air pressure carried is ¾-inch in the stoke-hole, burning 25.9 pounds of coal per square foot of grate, and giving 16.1 indicated horse power per square foot of grate, and .372 indicated horse power per square foot of heating surface.

The result of a good passage with very good American coal was 1 6 pounds of coal per indicated horse power per hour with American coal the full power developed is only about five per cent less than the Welsh coal.

This system is very simple, although the air-locks are inconvenient, and all the bunkers require to be air-tight, as the air would escape from the stoke-hole through them, as the bunker doors must always be left open (if there is any leakage the coal dust will be blown on deck). The inconvenience of air-locks is not so much felt in a large steamer, where the engineer remains a full watch in the stoke-hole. The stoke-hole is very dirty, especially with Welsh coal. The temperature of the stoke-hole was 116 degrees Fahrenheit, with the atmosphere at 62 degrees Fahrenheit mean of voyage.

B. Howden's, the second system, fitted in a sister vessel to the first, is a decided advantage in many respects. The stoke-hole can be left open to the engine room, and is much cleaner, there is just so much dust flying about. Care must be taken to make the uptakes and casings air-tight, or the arrangement is not so effective, as the gases escape into the stock-hole. This arrangement is worked with a shorter fire bar and burning a greater quantity of coal per square foot of grate, owing to being able to carry a higher pressure at fires through having valves for shutting off the draught while firing

Of course there are more complications on the boiler front which require attention, but there is an average saving of about eight per cent. in the coal bill over the first system, due to the heated air and retarders.

This arrangement is not so suitable for American coal as it is for Welsh coal. The falling off in full power, due to using American coal instead of Welsh, is about twice as much as it is in the vessel with the closed stoke-hole. The temperature of the stoke-hole is about the same as it is with the closed stoke-hole, system—116 degrees, with the atmosphere at 61 degrees. Taking the results from a good voyage with Welsh coal, with 3¾ inches air pressure at the fans, and 1¼ inches at the ash-pits, burning 28.2 pounds of coal per square foot of grate, that is with 18.6 I. H. P. per square foot of grate surface and .393 I. H. P. per square foot heating surface, the consumption is 1.52 pounds. of good Welsh coal per I. H. P. per hour.

C gives the results from a more recent arrangement of Howden's system on trial. When indicating on trial 21.13 horse-power per square foot of bar surface and 5.77 per square foot of heating surface, the temperature of the funnel gases was 496 degrees and air entering fires at 159 degrees, and 3½-inch W. G. pressure of air at fans, the heating surface of air heating tubes equal about one-third heating surface of boiler.

D. The Ellis and Eaves arrangement is the latest system of mechanical draught, and has been developed at Messrs. John Brown & Co.'s, Sheffield, where they have a large number of boilers working under this system.

The combination of Howden's and Martin's systems with Serve tubes makes a comfortable arrangement. The stoke-hole is open as with ordinary draught—in fact, it is just ordinary draught intensified by the fans. The air before reaching the furnaces is drawn through horizontal air-heating tubes The hot gases on their way to the funnel pass round outside these tubes so that the air is heated, as in Howden's arrangement on voyage mentioned, to 308 degrees Fahrenheit, the air drawn from above the boilers entering the air tubes at 117 degrees, and at fan delivery or funnel base 395 degrees. The heating surface of air-heating tubes was about the same as total heating surface of main boiler, or three times greater in proportion than Howden's arrangement. There is, however, this advantage: the furnaces are under less pressure than the stoke-hole, and a certain quantity of cold air can be allowed to enter from the stoke-hole below the fire-bars. This sweetens the air in the stoke-hole, as the air that is taken away is replaced by pure air from above, and any leakages about the furnace fronts or casings act in the same way, drawing in air. The temperature of the stoke-hole was only 80 degrees. A certain amount of cold air admitted under the fires does not appear to affect the economy much.

From experiments made at Sheffield, it was discovered that by raising the firebars a few inches at the back (instead of lowering them at the back in the usual way) the bars would allow the fires to be forced very much more severely and would give no trouble when burning over 80 pounds of coal per square foot of grate. Sloping the bars up toward the back has a further advantage, that it is easier to see that the whole of the grate is covered through the firedoor, and there is no chance of the flame being blown in your face. Another advantage the arrangement in this vessel possessed was the control the engineer had of regulating the quantity of heated air admitted above and below the bars, with peep-holes to watch the result while regulating. With bituminous coal all the hot air would be put over the fires and the smoke almost entirely consumed.

The consumption per indicated horse power (on voyage) of which particulars are given, was 1.41 pounds per hour with soft coal (not South Wales coal), which equals .539 I. H. P. per square foot of heating surface, and 17.13 I. H. P. per square foot of bar surface, and 24.2 pounds of coal per square foot of grate, with $3\frac{1}{4}$-inch W. G. vacuum at fan and chimney, and 1-inch W. G. vacuum at ash-pit.

I should mention that in firing and cleaning fires, the action of opening the door automatically closed off the draught from the furnace and prevented the cold air from rushing in. At Sheffield they think this an unnecessary precaution, and I do not think it is adopted there. They hold the opinion that with suction draught the heat impinging on the ends of the tubes and tube-plates is altogether different to what it is with forced draught. Th adherents of suction draught say it sweeps clear of the ends of the tubes and enters in the center, while with forced it impinges on the tube ends. Many other engineers maintain that the action is precisely the same in each case, the draught is due to difference of pressure at the base of the funnel and at the furnace mouth.

From experience at Sheffield they advise the air space at the back of furnace between the bars to be reduced, as the draught is more intense at the back end of grate.

The fans are about double the capacity in the suction arrangement of draught compared with the other arrangements, due to the gases having expanded by the heat, and the gas from the coal burned having to pass through the fans. Although double the capacity, the adherents of suction draught maintain the fans do not require double the power, as the work done is much the same, whether you put the power at either end of the conduits, but the fans, being larger and heavier, have more friction, and are said to require 25 per cent. more power to work them in handling the lighter gases.

E. The Closed Ashpit System is the fourth arrangement mentioned. Although, perhaps, the oldest, this is the least adopted, through the fear of using cold air under a high pressure. The arrangement works very well if properly designed. You can get a very high power from a light boiler, but you must take the precaution not to inject the air directly into the ashpit, only arrange it so that the air is circulating all over the furnace front, and let pressure into the furnace at various parts above and below the bars.

The stoke hole is quite open in this system, and it has this advantage over all the others, that you have merely to open the ashpit doors and stop the fans in order to work with natural draught. The fans draw from the engine-room or stoke-hole, as desired, and keep the engine-room and stoke-hole more comfortable than with natural draught. You will notice from the table that with this arrangement the power on trial was very high for the weight and heating surface—22.6 I. H. P. per square foot of bar surface and .714 per square foot of heating surface, with 1 inches air pressure at fans and 2 inches at ashpits.

Under ordinary cruising conditions the power was reduced to 13.3 pounds of coal per square foot of bar surface, and .418 I. H. P. per square foot of heating surface. The consumption was 1.56 pounds of Welsh coal per I. H. P. per hour, with $1\frac{3}{4}$ inches air pressure at fans. This arrangement has also been working satisfactorily for years.

The results given are from a similar arrangement to that so well worked out by Mr D. J. Dunlop, Port-Glasgow, and published in *Engineering*, March 18, 1892, fitted in the yacht *Mira* which had the exciting race from Cloch round the Cumbraes with the yacht *Hermione*. This was a private tussle—closed ashpit *versus* Howden—and ended in a victory for the closed ashpit by several minutes. Both yachts were designed by the same naval architect.

I annex a sketch of Ellis and Eaves' combination. The other arrangements are so well known that sketches are unnecessary.

The sketch shows the arrangement as adopted for land purposes at Sheffield. For marine work I think it would be advisable to draw the air through outside the tubes, and let the coal gases pass through the tubes; they could then be swept when overhauling in port from outside the heating box, same as boiler tubes.

In further reference to the table of comparisons annexed, the first two refer to mail steamers kept continually working at full power. They are exactly the same in every respect, except the system of draught employed. These two steamers when working under favorable conditions, the closed stoke-hole made the fastest passages with American coal and the Howden system the quickest with Welsh coal, but latterly the closed stoke-hole is quicker, taking all last season on an average, of six hours per passage. This vessel was not designed to suit Howden draught originally, but the boilers were designed to suit forced draught. The average consumption of average voyages with Welsh and American coal takes 10 per cent. more coal per indicated horse power than mentioned in table. The furnaces with the closed stoke-hole arrangement stood quite as well as with Howden's draught, but the tubes began to leak at combustion chamber end, and her boilers had to be retubed at a much earlier date than with Howden's draught.

Altogether, it is a very creditable result for the Admiralty system where you can afford to carry weight for engines large enough for economical working with a good number of expansions.

The indicated horse power per ton of boilers and machinery is almost as great in these two express vessels on ordinary work as the others on trial. This is where the human element comes in. The indicated horse power per ton of machinery is very nearly alike in the other examples.

The second two refer to swift cargo steamers of the same type.

The fifth column refers to a yacht of 1,500 indicated horse power, showing that a large horse power can be obtained with this arrangement when necessary. With it natural draught can be adopted, and save the decks from the discharge of ashes caused by forced draught.

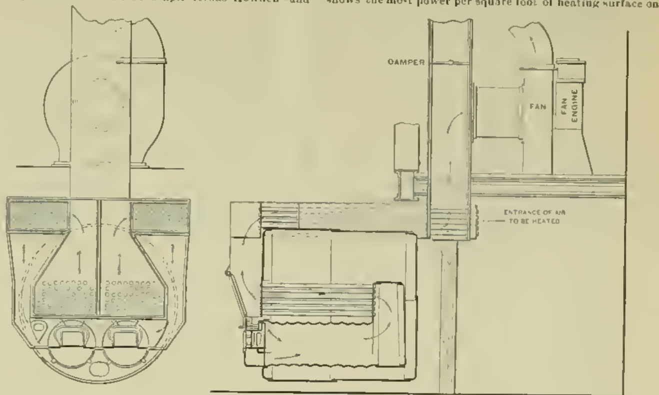
Generally, I have no doubt that examples might be ob-
voyage. This should be expected, as it is the only one fitted

COMPARISON OF MECHANICAL DRAUGHTS.

	A Closed stoke-hole system.	B Howden's system.	C Howden's system.	D Suction system.	E Closed ashpit system.	F Natural draught system.
Engines and working pressure	Triple, 160 lbs.	Triple, 160 lbs.	Triple, 180 lbs.	Quadruple, 200 lbs.	Triple, 170 lbs.	Triple, 165 lbs.
I. H. P. per square foot of grate—trial	......	......	24.13	21.7	22.66	14.73
I. H. P. per square foot of grate—voyage	16.1	18.6	16.96	17.13	13.3	10
I. H. P. per square foot of heating surface—trial	......	......	.577	.682	.714	.5
I. H. P. per square foot of heating surface—voyage	.372	.393	.405	.539	.418	.316
I. H. P. per ton of boiler and appurtenances—trial	......	......	16.8	14.7	19.6	15.9
I. H. P. per ton of boiler and appurtenances—voyage	13.71	13.71	11.8	11.6	11.51	11
Length of firebars	6 ft.	5 ft. 3 ins.	5 ft. 3 ins.	5 ft. 9 ins.	6 ft.	5 ft. 6 ins
Pounds coal per square foot of grate—voyage	25.9	28.2	25.3	24.2	20.7	15.4
Pounds coal per I. H. P. at time cards were taken	......	......	1.4	......	......	......
Pounds coal per I. H. P. per hour, mean of voyage	1.6	1.52	1.51	1.41	1.56	1.53
Quality and purpose used for	American, very good, used for propelling machinery only.	Welsh, good; used for propelling machinery only.	Soft coal, used in main boilers for all ship's purposes.	Soft coal; used in main boilers for all ship's purposes.	Welsh; used in main boilers for all ship's purposes.	Soft coal; used in main boilers for all ship's purposes.

tained from any of these systems, showing a greater power obtained from the coal or from the weight, but the examples I have taken are from vessels under or about the same conditions for a fair comparison.

On trial, in the instances mentioned, the closed ashpit arrangement is much superior to all the others in indicated horse power per ton of machinery, and Ellis and Eaves' system shows the most power per square foot of heating surface on



The Ellis and Eaves Arrangement for Induced Draught.

with Serve tubes, but I do not think the full advantage of these tubes has yet been taken in designing boilers. I have advised in boilers now building to reduce the number of tubes. In that way we get larger furnaces, and greater power from the same dimensions of boiler, and depend on the heat absorbing power of the Serve tube to make the heat distributing furnace more effective. The Serve tubes will be worth paying for under these conditions. Howden's arrangement shows the greatest power per square foot of grate both at trial and on voyage, due to using shorter firebars.

From my own experience I know that each of the systems can be made to work very satisfactorily. The furnaces will not give trouble with any of these systems so long as the air is properly admitted, although, naturally, one would be led to suppose that the heated air would do the furnaces less damage.

The most economical arrangements are the heaviest, probably because of the air heating tubes which are employed in these systems. When the length of voyage is limited it becomes questionable whether the increased economy is worth obtaining when it is necessarily accompanied by increased weight. But in the case of a long voyage the smaller consumption will necessitate less coal to be carried, and so the total weight of boilers and coal will be less than when lighter systems are employed.

The fans themselves are the most important factor of any forced draught system. When the fans are too small they have to be overdriven, and soon come to grief. I have found that a good empirical rule for the capacity of the fan is—

$$\frac{\text{Width at periphery} \times \text{dia.} \times \text{cir., all in feet}}{3}$$

= cub. ft. of air per rev.

Allow for 250 cubic feet of air per pound of coal to allow for leakages, etc. Of course you will require to see that the speed of the fan periphery is suitable for the amount of air pressure to be carried, say—

$$8\sqrt{18 \times \text{inches water gage air pressure}}$$

= speed of fan tips in feet per second to balance inches water; multiply by 60 and divide by circumference of fan in feet = revolutions of fan per minute for forced draught.

If you leave the proportioning of the fans to the fan makers they are apt to supply fans which are much too small for the work required, in order to reduce the price.

If the fans are over double the capacity given by this rule they can be depended upon to work in the funnel glass after they have been reduced in temperature by the air-heating tubes.

These air-heating tubes have been the saving of the induced system. When the fans are put direct in the funnel, as originally fitted, it is quite probable that you might find only the stumps of the blades left after the trial when consuming a large amount of coal with small heating surface.

Another decided improvement was that adopted by Messrs. J. & G. Thomson in the vessel from which the particulars are given, namely, in placing the fans on brackets on the casing of the vessel instead of on the hot uptakes, which soon heat up the fan base.

I should mention that all the arrangements mentioned are now fitted with retarders except the natural draught example. This seems to be an important factor in the economy derived from forced draught.

Some owners think it a greater invention than that of the triple-expansion engines, because, fitting it to some of their steamers when the conditions were favorable, the saving was as much as 10 per cent. of coal.

I should mention the consumption of coal per indicated horse power is arrived at by reducing the indicated horse power calculated from the diagrams at the revolutions the the engines were then working, to the power equal to the mean revolutions from the counters on the voyage as the cube of the revolutions and the total coal consumed between ports, according to the American navy practice.

A friend proposed to add the particulars from a good modern ordinary draught steamer to the table for comparison at *F*: this I have done. All the steamers have the same style of feed-heater except *E*, which is not fitted with one.

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The experience of the New York Central road with extended piston rods for locomotives has been so favorable as to make reasonable the belief that the saving in wear of cylinders and pistons more than compensates for the expense and maintenance of the additional parts. The extended rods have been fitted to quite a number of the heavy 19 inch passenger engines hauling the Empire State and other fast trains, and as these engines come into the shops for general repairs their cylinders have been examined and in a number of cases it was not found necessary to do any work on them, they being sent out untouched for another two years of hard running. Engine No. 870, well known for its regular work on the Empire State Express made 187,176 miles while out of the shop and the wear of the cylinders was less than $\frac{1}{64}$ of an inch. Officials from other roads have been impressed by the record made and it is possible that extended piston rods may be used more extensively on heavy engines in this county and viewed more favorably by railroad men than heretofore. The packing used in the case cited above consists of three cast iron spring rings.

The use of a heavy anvil supported on springs in connection with a drop-testing machine, as illustrated on another page, is a genuine and truly scientific improvement of a machine that has heretofore been somewhat crude. A drop of 1,640 pounds falling from a given height has a fixed amount of energy stored in it, but the force of the blow given to the object on which it falls depends upon how suddenly its motion is arrested. If neither the object nor the foundation under it yielded in the least the force of the impact would be infinite, but with the smallest "give" the force of impact comes within the domains of the finite, and is rapidly reduced in amount as the yielding of the object increases. For this reason the weight of the anvil and the character of the foundations under it have had the effect of modifying the effect of the drop and making it difficult or impossible to accurately compare the results obtained from different machines or the same machine at different times. But by providing an anvil sufficiently heavy to take care of the force of impact without the aid of the foundations and then interposing springs that effectually prevent these foundations from having any influence whatever, the resistance to the force is made as constant as the force itself, and comparable results are obtained. The value of this improvement will we think be generally recognized.

The suggestions for the economical designing of timber trestle bridges sent out by the Forestry Division of the Department of Agriculture, and published in abstract elsewhere in this issue, will doubtless be read with interest by those concerned in the design and maintenance of such structures. The scaling down of the sizes of timbers at present used to conform to reasonable factors of safety, as determined by tests made under the supervision of the Forestry Division, cannot be objected to from a purely theoretical standpoint, but the impossibility of getting quickly the various odd sizes thus decided upon, the necessity of keeping many more sizes of timber in stock, and the greater difficulty of keeping track of the sizes needed for emergency work at any given trestle, all have had their influence in molding the practice of to-day and will have to be duly considered before any great change is made. But while there may not be unanimous approval of the suggestions of the Forestry Division, the general argument for economy of material in the construction of trestle is timely, particularly as engineers, with the results before them of the valuable and exhaustive tests and investigations made by the Division, are for the first time placed in a position where they can design such structures with an accurate knowledge of the strength of the materials employed. These valuable timber tests, as they are carried to completion for the various species of woods, will enable engineers to intelligently inaugurate economies. At the same time suggestions from the department on the practical application of results of the timber tests conducted by it, are next in importance to the tests themselves, for engineers as a class, in common with the rest of mankind, are none too quick to see the practical uses to which data obtained by scientific research can be put; the suggestions of the Department may not be followed to the letter, but they will certainly be prolific of good, in that they will induce engineers to make a more extensive use of the information than would otherwise be the case.

Before leaving this subject we would call the attention of engineers to the fact that though the tests have thus far cost only $40,000, it is probable Congress, if left to itself, will fail to appropriate the small amount necessary to carry on the work for the fiscal year. If engineers and others will write to the Congressmen of their States urging upon them the value of the work and the wisdom of an appropriation, the funds will doubtless be forthcoming.

In specifying the physical qualities of boiler steel it is customary to designate a desired tensile strength and elongation, and to state the limits above and below these figures within which the manufacturer must work if his material is to be accepted. Thus, if the desired strength is 60,000 pounds and the elongation 25 per cent, the specifications would probably be so framed as to accept steel of a strength not less than 55,000 pounds or more than 65,000 pounds per square inch, with an elongation of 25 per cent. or more. Some such latitude is necessary or the specifications would be too rigid and cause needless trouble and expense. But with the knowledge that within certain limits, a reduction in the tensile strength of a given quality of steel permits of greater elongation and an increase in strength has a tendency to reduce the elongation, it is apparent that a manufacturer who furnishes a steel of more than 60,000 pounds strength and 25 per cent. elongation is really producing a better material than called for in the specifications, while if its strength is less than 60,000 pounds without greater elongation, it is inferior. Consequently, if a road wishes to get an equally good steel for all strengths within the limits specified, and yet not demand from the manufacturer more than it is entitled to, it should require a greater elongation in the lower part of the scale of strengths and be content with less elongation in the upper half of the scale. The Pennsylvania Railroad has met this point very nicely in its specifications by requiring that the product of the tensile strength and elongation shall not be less than a certain figure. For shell steel the specifications say: "These plates will be rejected if the test piece shows: 1, A tensile strength of less than 55,000 pounds per square inch; 2, An elongation less than the quotient of 1,400,000 divided by the tensile strength; 3, A tensile strength over 65,000 pounds per square inch; should, however, the elongation be 28 per cent. or over, plates will not be rejected for high strength." For fire-box steel the corresponding clause reads: "These plates will be rejected if the test piece shows: 1, A tensile strength of less than 55,000 pounds per square inch; 2, An elongation less than the quotient of 1,450,000 divided by the tensile strength; 3, A tensile strength over 65,000 pounds per square inch; should however, the elongation be 30 per cent. or over, plates will not be rejected for high strength." From this we see that if the strength of fire-box steel is 55,000 pounds the elongation must be at least 26.4 per cent. if 60,000 pounds, 24.1 per cent., and if 65,000 pounds, 22.3 per cent. This sliding scale of strengths and elongations is a neat way of providing for uniform quality, and is just and equitable to all concerned.

While the details of the various kinds of starting valves for two-cylinder compound locomotives differ considerably, the valves themselves may be generally divided into two classes—those which automically change the engine from simple to compound working and are not under the control of the engineer, and those which are non-automatic in the sense that the engineer can at will operate the engine as a simple one, either at starting or after the train is in motion. In the latter class the proportion of parts and passages is such that no additional power is obtained by working the engine simple except at low speeds. Of late the drift of opinion seems to be in favor of starting gears of this last mentioned kind, and there certainly appears to be some superior advantages in this method of construction. Many divisions of important railroad lines have limiting grades which decide the load which an engine can be assigned, this load of course falling far below what the engine can economically handle on the remainder of the run. If the operating and mechanical departments wish to increase the weight of trains hauled on such divisions in the interest of economy, it becomes necessary to build larger engines or use helpers. Assuming that larger engines are decided upon, these new locomotives, like the old ones, will be greatly underloaded on all but the hills. Now, if a road with such physical characteristics elects to build compound engines for this traffic, it will find that the style of starting gear employed may make some difference in the size of the engine. If the engine cannot be worked simple at the will of the engineer, it must be made powerful enough to take the maximum load over the heaviest grade while working compound; on the other hand if it can be worked simple with increased tractive power on the grade, the cylinders can be somewhat smaller, with the result of making them better adapted for working economically on the level; or to put it another way, with the same size cylinders the engine that can be made to work simple on the heaviest grades will not only take a heavier train over the division, but be better loaded for economy on the level portions of it. A tramp compound engine of the 10-wheeled type sent out by one builder, and tried on many Western roads, was capable of exerting about 18,000 pounds draw bar pull when working compound at slow speeds, but by throwing it into a simple engine the maximum drawbar pull rose to nearly 24,000 pounds, and several times this advantage enabled it to take trains over grades on which it otherwise would have stalled. These considerations have doubtless influenced opinion in favor of this type of starting gear, though it is apparent that the advantage mentioned would be of lesser importance on a practically level road.

THE MASTER MECHANICS' CONVENTION FOR 1896.

With the approach of spring the committee of investigation of this association, which were appointed at the meeting of the previous year, begin to bestir themselves in the preparation of their reports and the collection of data to be submitted to the coming meeting. At most other engineering associations the proceedings or "transactions" consist chiefly of papers written by members on subjects selected by themselves, and concerning which it is assumed they have some special information which is worth communicating to their fellow-members and the public.

The system which is followed in the Master Mechanics Association and its congener, the Master Car Builders' Association, and has been practised ever since they were organized, is somewhat different from the methods adopted by other analogous associations. At each meeting a committee is appointed to find subjects which it may be thought require investigation, and concerning which interesting and profitable reports might, could, would or should be made. The constitution of the Master Mechanics' Association then provides that "when the committee on subjects has reported, and the association approved of subjects for investigation, the President shall appoint special committees to investigate and report on them, and may authorize and appoint a special committee to investigate and report on any subject which a majority of the members present may approve."

It is a sort of unwritten law of the association, that no member shall refuse to accept such an appointment, and it is usually regarded as a compliment to be placed on a committee of this kind.

This year the technical bill of fare which has been prepared is an unusually inviting one, and the committees appointed, with perhaps the exception of the tail end of No. 10, are of such a character that excellent reports may be expected from them.

To those of us who have been listening to reports read before this association, for a quarter of a century or more, some suggestions naturally occur. We recall the fact that the reports may be roughly though very distinctly divided into two classes—those which bore the audience to which they are read and those which don't. Now it may safely be said that as soon as the boring begins the profit ends, and when the listeners begin to yawn they are no longer instructed. In a report which is intended to be read to an audience as miscellaneous as that which assembles annually at these conventions, the first thing to guard against is over-straining the attention of the hearers. It should be remembered that the attention which the listeners can or will give to a paper, report or address, is very limited and is soon exhausted. Probably, if they were entirely frank, most persons who have for any considerable time been attendants at the meetings of technical societies would admit that most of the papers and reports which are read are very tiresome. Unfortunately, most people think that what they have written will be, or should be, interesting to others. So inordinate is human conceit and vanity that few of us ever candidly consider whether if some one else had written what we have, and should read it to an audience of which we formed a part, we would be interested, instructed or wearied by it. Now, the other fellow, to whom we read our papers, is just as apt to be bored as we are when he reads his to us, providing neither of them contains food for instruction or overpasses our capacity for consuming and digesting it.

In mechanical construction we always keep in mind the limit of elasticity of the material used before we load or strain it. If we are wise, we will consider the elastic limit of an audience before we impose too great a natural strain on the attention of those who compose it.

There is another reason too why reports prepared for the Master Mechanics' and kindred associations should be limited in length. Their purpose is generally to present the various aspects of the subject, so that it may be intelligently discussed after the report is read. If an audience is tired out by listening to a too lengthy dissertation there will not be sufficient mental power left to carry on a profitable discussion. To call out a good debate of a subject at such meetings, it is therefore of the utmost importance that the report should be brief and terse and that the facts, principles and deductions, should be presented so that they can be readily grasped by the hearers. If the treatment is rambling, loose-jointed and discursive, those who compose the audience are apt to fall into a sort of mental disintegration, and a motion is apt to be made that "the discussion be closed" and an extinguisher is thus put on the whole matter.

The following are the general subjects on which reports are to be made at the Master Mechanics' Convention this year:

1. Exhaust Nozzles and Steam Passages—Continued
2. Counterbalancing Locomotives.
3. Slide Valves.
4. Reciprocating Parts.
5. Cylinder Bushings.
6. Hub Liners.
7. Steam-Pipe Joints.
8. Driving-Box Wedges.
9. Steps and Handholds.
10. Truck Swing Hangers.
11. Locomotive Grates.
12. Thickness of Engine-Truck Wheel Flanges.
13. The Apprentice Boy.
14. To Harmonize Standards.

The regular hours for the sessions are from 9 a. m. to 2 p. m., the meetings being continued for three days, so that altogether 15 hours are devoted to the business and the transactions of the convention. Besides the reports on these subjects, there will be the opening exercises, the address by the President, reports of Secretary and Treasurer, and a considerable amount of routine business, which is quite sure to consume from two to three hours of the first day's meeting. From 10 to 1 o'clock on each day is usually devoted to the discussion of questions propounded by members. The election of officers, and other business usually consumes at least another hour, so that nearly half the time of the convention is occupied with business outside of the reports of the committees on technical subjects. There is therefore only from seven to eight hours left for their reading and discussion. As there will be 14 of them this year, there will be on an average, barely a half hour, which can be devoted to the reading and the discussion of each.

Last year* we made a rough estimate of the total cost of holding one of these meetings, which indicated that it was somewhere from $50,000 to $100,000. The ultimate purpose of this expense is to bring the members together for 15 hours to deliberate on the subjects which were selected a year ago and have been enumerated above. Each hour of this time therefore costs somewhat more than from $3,000 to $6,000, and the cost of the minutes is from $50 to $100, and the value of the seconds is nearly $1 to $2 each. It will therefore be seen how extremely expensive a windbag is or a number of them are on such occasions. Obviously economy of time is of the utmost importance, and a lengthy report is out of place. None of them should take more than fifteen minutes to read, and if they were confined to five or ten would be better. If the material collected by any of the committees is of such a character that it cannot be condensed so as to be read in that time then whatever would be excluded should be submitted with the reports in the form of appendices, to be printed, but not read, the committee giving only, in a general way, the methods and results of their investigations. The prodigal sons at these meetings are the members who waste the time by rioting in talk, and

"Idly running on with vain prolixity."

In view of the expense which is incurred, and the consequent cost of the time devoted to the meetings, it would seem as though it might be a good plan to have placards printed and posted and reading somewhat as follows:

The cost of holding these meetings is from one to two dollars for each second of time devoted to its deliberations, from $50 to $100 for each minute, and from $3,000 to $6,000 for each hour. Speakers are therefore requested to be as concise as possible and not waste the time, which costs so much, by observations not important or not relevant to the subjects under discussion, and it is suggested that each of them before speaking should calmly and interrogatively consider whether he would derive either entertainment or profit from listening to what he intends to say if it came from the mouth of another member.

*See *American Engineer* for July.

There is, though, an obverse side to this view of the meetings, while the influences which detract most from their interest and profit is the loquacity of the bores and windbags, it is essential to the success of the meetings that those who are neither, and who are possessed of valuable experience, accumulated knowledge and of that kind of horizontality of mind which is of such great service to all of us in the perplexities and conduct of life, and who it may be, instead of being addicted to loquacity are disposed to be taciturn, should speak with the utmost freedom. Unfortunately no check-valve has ever been invented which will admit clear water to a boiler, but will close when that which is muddy is fed to it. An invention which would perhaps have still greater value, would be a sort of parliamentary check-valve, which would shut up the turgid speakers at meetings of deliberative bodies, and would open wide when a clear and pure stream of talk and thought is turned on. Many persons who are interested in the subjects which are to be reported on at the meeting which is now being discussed, would like immensely to learn what others know or think about some of them. It might not be a bad plan to request certain persons to consent to examination and cross-examination—after the manner which prevails in courts of justice—on some of the subjects in the above list. The writer confesses to an itching desire to cross-examine the Committee on Exhaust Nozzles and Steam Passages, and he would like to call some of the members of the Committee on Counterbalancing Locomotives to the stand with the privilege of asking questions to an unlimited extent, and probably no more interesting report could be made than that which might be compiled if the privilege were given to any one concerned in the subject to select certain members of the Association and ask them such questions as he liked with reference to whether it is safe to run pony trucks under fast express engines.

When a subject of importance is fairly brought before the Association, so that the members have a distinct comprehension of it, it is then of the utmost importance that discussion should in every way be promoted. If for a moment we consider the successive steps which have led up to this juncture, it will be seen how essential it is that nothing should interrupt the consideration of the subject which has thus been presented. In the first place, a year before the duty was imposed on a committee to select subjects for investigation. Having done this, another committee, who, it was assumed, were the fittest available persons for that task, was delegated with the duty of preparing a report, and during the year intervening they have given more or less time to the consideration and investigation of the matter submitted to them, and the Association has the right to expect that the committee will summarize all the available information and expense relating thereto which is accessible to them.

The members of the Association, who are fairly well paid men, give up their usual duties, travel hundreds or thousands of miles to attend these meetings, the purpose of which is to hear and consider such reports on subjects selected. A few hundreds of members there assemble together and are all avid and alert for information. A report is read under these circumstances. The Association may then be likened to a foundry cupola—it has been charged, the fire kindled, the blast turned on, and the metal is molten. The cupola is then tapped and the iron flows with vigor and brilliancy and could then all be drawn out and cast into useful forms. When at these meetings—to continue the similie—part of the metal has flowed out, a member who is not interested in the discussion will often rise and insert in the tap-hole a plug of cold clay, in the form of a motion that "the discussion be now closed." The motion is accepted, and the flow of discussion is than ended, and the molten thought which might have assumed useful form is allowed to cool and solidify in chaotic shape, and can then only be again brought to a fluid condition after much labor and time and heat has been expended on it. When an audience, having the knowledge, intelligence and experience which the members of the Master Mechanics' Association have, is prepared to hear and discuss a subject for the consideration of which they have come together, a sudden plugging up of the flow of mentality defeats the very purpose of their assembling together, and yet this is just what occurs over and over again through the action of some dull members who have, perhaps, not wit enough to be interested in or to comprehend the subject before the house. When the cupola has been heated the molds are ready and the metal molten, that is the time to draw it off and cast it into forms and objects which will be permanently useful. In other words, when an audience is assembled and is in an attitude of mind to deliberate on a subject, it is a waste of all the effort which has been made to bring it together to permanently stop the flow of ideas which are then fluid.

Quite a good many years ago it was suggested by Mr. Coleman Sellers, whose absence from these meetings for so long a time is so much to be regretted, that every report made to a body like this Association should end with a recommendation or resolution embodying the conclusions of the committee which made the report. Such resolutions would be open for discussion, and by being distinctly formulated would help to lead and to keep debate within limits which would be relevant to the matters at issue. Most of the committees could not do better than to end their reports with one or more resolutions, which, of course, would be submitted for adoption or rejection by the Association. Such resolutions would then represent the consummation of the committee's work, and would briefly summarize their conclusions.

THE PROPOSED INTERNATIONAL STANDARD FOR SCREW THREADS.

The Swiss Government has invited European nations using the metric system of weights and measures to confer with it with the view of selecting and adopting a uniform gage for screws. As neither England nor the United States has adopted the metric system they have not been invited to participate in the councils of this convention. The decision of this conference will, nevertheless, be of great importance to the English-speaking nations. Great Britain already has a large foreign trade in machinery and manufactures that must ultimately be made to conform in detail measurements to metric standards, and American manufacturers, many of whom have been content for years with American markets, will eventually wake up to the fact that they must have foreign markets, if only to maintain a more even rate of production and minimize the effect on their business of the fluctuations in demand in the home markets. When this time comes we too will be concerned in metric screw threads and other standards which European manufacturing nations have adopted.

Fortunately for American manufacturers and engineers who are thus without representation in the decision of a matter which will some time be of such importance to them, the standard likely to be adopted is that of the French Admiralty. This gage closely resembles the Sellers threads, which are standard in this country. The shape of the French thread is identical with that of the Sellers, and the pitches for the various diameters closely resemble the Sellers, being on the whole somewhat finer, and each size being, of course, an integral number of threads per decimeter. If, therefore, we are ever required to adopt as our standard the decision of this convention, the new standard may be expected to conform closely to what the experience of our leading engineers and manufacturers have found to be desirable.

The time seems to be near at hand when international standards of measures and weights should be in effect in all civilized nations and not adopted by the few. This being the case, it would be fortunate if no action looking to the adoption of a standard of this kind would be taken without the co-operation of all. It may appear that in the selection of such a standard as metric screw threads, nations not at present using the metric system have no interests, but this is not so if there is anything in the idea that a uniform system of measurements is ever to be in force in all civilized nations. The earlier that all can have a share in the establishment of standards intended to be international, the sooner will the use of the standards become general.

The advocates of the metric system have urged upon the English and American public some so-called advantages of the system which can easily be shown to be a myth. The derivation of the unit of a system is of little or no importance, but the convenience of the sub-divisions of that unit and the extent to which the system is used, are of vital moment. We believe the convenience of the metric system and its general adoption in the countries whose markets American manufacturers and merchants will endeavor to enter or are even now striving to supply, will eventually lead to its adoption here. Great Britain and America cannot afford to use one standard of measures for home markets and another for foreign ones, and as the foreigners will not come to us, we will have to go to them in this matter. Even now the House of Commons in England has before it a measure to compel the adoption of the metric system in two years and there are rumors of a bill to be presented to Congress at Washington compelling the adoption of the same system in this country, by the year 1900. But it is questionable if such legislation will be enacted or if enacted will succeed in bringing about the desired result. Commenting on the English measure *Engineering* says:

As regards the possibility of carrying out the recommendations of the committee, we may say, in the first place, that it is very doubtful if the necessary standards could be prepared and verified in the time named. The manufacturers would probably contrive to produce the millions of measures of weight and capacity needed to replace those now in use, but unless the Government displayed unheard of activity, it is certain that the testing and stamping could not be done in that time. These matters, however, do not greatly affect engineers, as they seldom sell by lengths or weights, at least not in the sense that the shopkeeper does. Nevertheless, the change promises to provide them with troubles enough of their own to make them look forward to it with anxiety. It is one of those things every one wishes well over. That it will be enormously beneficial must be conceded by all. The time has gone past when it is necessary to furnish arguments as to the advantages of the metric system over our own confused methods. Those whose business it is to deal with foreign countries know best how much they lose when they come into competition with manufacturers from Germany and Belgium, from the inability or indisposition of other nations to comprehend the standards we follow. We regard it is an absolutely foregone conclusion that the metric system will be adopted here, and the only points open to discussion are how the transition can be made most easily, and how far can advantage be taken of the change to establish certain international standards, which would have great commercial value

If the above sentiments correctly represent the opinions of English manufacturers, it will not be long before the United States must adopt the metric system or find itself alone in its opposition. If the change is once undertaken in the proper spirit it will probably prove less troublesome and expensive than expected, though it will be no trivial task

The Tobacco Nuisance.

Our comments on the "abomination of expectoration" in cars and elsewhere, published in February, have called out the following letter from a correspondent

I note what you say in your February number about the offensive habit which many people have of spitting on the floor in public conveyances or public places. The writer desires to thank you for your superlative utterances on this subject. I can endorse them all! But there is another intolerable nuisance which the suffering public has to bear, which is a more nauseous, execrable, offensive, odious, loathsome, horrible, detestable, foul, unwholesome, beastly and infectious practice than the other is or can be, and that is the intolerable nuisance of tobacco smoke, the long-suffering public has to bear as they travel in the crowded streets or congregate in public places. I, too, "am not a woman, nor the husband of one," but I am perfectly aware of the intolerable nuisance which tobacco smoke is to most women; but they have to grin (?) and bear it, because they cannot help themselves, and there is not more than one smoker in fifty who stops to consider whether their tobacco smoke is disagreeable to other people or not The writer has a near friend who was at one time an inveterate smoker, but after a severe struggle gave up the habit, and now this same man tells me that he never knew before what an extremely selfish person he had been, and what a perfect nuisance he must have been for years by smoking

Mr. Editor. Will you not kindly for the sake of women, as well as non-smoking men, who detest tobacco smoke, lend your pen to call the attention of selfish smoking men to the unmitigated nuisance they make of themselves, to the non-smoking part of the community, as they walk the crowded streets and burn incense to their idol. Can't we have a law in New York as they have in some other cities prohibiting any person from smoking in a crowded street? Yours for comfort and cleanliness,

East Orange, N. J. R. A. Hutchinson.

The sentiments of our correspondent are those of the editor-in-chief of this paper. Similar opinions have also been held by—we were about to say—other distinguished men. Thus Dr Oliver Wendell Holmes on being asked whether a young man should smoke, emphatically replied: "Certainly not. It is liable to injure the sight, to render the nerves unsteady, *to enfeeble the will* and enslave the nature to an imperious habit likely to stand in the way of duty to be performed."

Burton in the *Anatomy of Melancholy* says: "Tobacco, divine, rare, superexcellent tobacco, which goes far beyond all panaceas, potable gold, and philosopher's stones, is a sovereign remedy in all diseases. *A good vomit*, I confess, a virtuous herb, if it be well qualified, opportunely taken and medicinally used; but, as it is commonly abused by most men, which take it as tinkers do ale, 'tis a plague, a mischief, a violent purge of goods, lands, health hellish, devilish and damned tobacco, the ruin and overthrow of body and soul."

Another old worthy named Sylvester, who wrote a book or an essay on "Tobacco Battered," says:

> "Tobacconing is but a smoakie play,
> If their tobacconing be good, how is't,
> That lewdest, loosest, basest, polishest,
> The most unthrify, most intemperate,
> Most viscious, most debaucht, most desperate
> Pursue it most?"

The same writer also says:

> "A tabacconist, I dare aver,
> Is first of all a rank idolater."

Again he says.

> "Hell hath smoak,
> Impenitent tobacconists to choak"

Professor Reynolds, in an address delivered some years ago before the Hospital College of Medicine, said:

"It is a well known fact that tobacco deranges the digestion and poisons the nerve centers of a majority of the male members of the human family. A species of blindness, not complete, but partial blindness, sufficiently great in extent to destroy the reading of ordinary type, results from the continued and excessive use of tobacco. Careful investigations have led to the discovery that that form of tobacco habit known as smoking produced the so-called amblyopia. This form of amblyopia is precisely identical in all respects with that produced from the excessive use of alcohol. Both are incurable. . . .

"Smoking tobacco has never been known to result beneficially to any person in the world *It always lessens the sense of smell and taste*; it always contaminates the breath: it always creates an unsteadiness of the muscles, through its irritating effect upon the nerves; and I know from personal experience it diminishes the capacity for mental labor."

The celebrated Dr. Döllinger said on the same subject:

"The eternal smoking of pipes and cigars by our forefathers doubtless helped to bring about the short sight which has now become hereditary in Germany. Tobacco-smoking is the ruin of society and of chivalrous conduct towards women. The tone becomes less refined, conversation suffers from it. For a long time I have avoided any society where smoking is allowed, and often travel first-class in the railway solely to escape the disagreeable, unwholesome atmosphere."

At a meeting of the Anti-Tobacco Society, held in Manchester, England, some years ago, the statement was made "that careful statistical investigation has shown that teetotallers who smoke are five times more liable to fall away than those who do not."

Medical authorities are agreed that, taken in moderate quantities it calms restlessness and produces a state of gentle langour or repose; or acts as a harmless excitant and sedative, but "yet it is a frequent cause of paralysis when the practice is indulged in to excess. Oil of tobacco which is inhaled and swallowed in the process of smoking, is one of the most violent of known poisons. The Hottentots are said to kill snakes by putting a drop of it on their tongues, and the death of these reptiles is said to take place as instantaneously as if by an electric shock"

There have been occasions when we have been inclined to regret that this poison of tobacco was not as deadly to some smokers as it seems to be to venomous serpents. That the habit is attended with some risks is shown by the following tale told by the *British Medical Journal*. That paper says:

"A gentleman was ordered some ordinary chlorate of potash lozenges for a sore tongue, and for convenience he kept them loose in his waistcoat pocket, as scores of people have done before. Now, as ill-luck would have it, this gentleman also bought a box of Swedish safety matches, and these he also put into the same pocket. Now, a moment's consideration of what a safety match is tells us at once the whole catastrophe. To prevent matches going off of themselves the makers separate the ingredients, putting the phosphorus on the box and the chlorate of potash on the matches. While bending down to pick up something on the floor the lozenges rubbed against the friction paper on the outside of the box. This set the entire box alight, and the heat kindled all the matches in the box. The heat generated decomposed the chlorate lozenges, and the oxygen set free intensified the combustion tenfold. The result was the gentleman was instantly in flames, the combustion being of explosive violence. Had not a pail of water been thrown over him instantly the result must have been fatal, as the combustion was inconceivably violent.

Amaurosis, which it is said is produced by smoking, is defined to be "a loss or decay of sight from loss of power in the optic nerve, without any perceptible external change in the eye."

A much worse—and it is believed a common effort is what may be called mental and moral amaurosis or the weakening of what may be called the nerves of the mind, will and moral perception. A common symptom of this condition is the lack of perception by smokers, as our correspondent says, "that they are making nuisances of themselves." When a smoker with much indifference puffs his vile vapors, as they often do, into the faces of persons to whom it is disagreeable, it can only be attributed to two causes—either to mental dullness, that is inability to know that it is disagreeable, or to moral strabismus or lack of consideration for the comfort of those about them.

This leads up to what is the real purpose of this article which is smoking at technical meetings—such as those of Railroad Clubs, the Conventions of the Mechanical Engineers, Master Mechanics and Master Car Builders. At the January meeting of the New England Railroad Club this subject was brought up by Mr. Chamberlain who said that complaint is made that smoking during the sessions of the club is very embarrassing to those who do not use the weed—that is to some. It clouds the room, which finally causes the window to be opened to let the smoke out, the result being that there is great liability to catch cold, and in deference to these members who do not smoke, it has been suggested that a motion be made prohibiting smoking, in order to get the sense of the club with reference thereto. On motion of Mr. Adams, it was decided that from this time forth there should be no more smoking, which was unanimously carried. Not only is smoking very disagreeable to many people, but, as is claimed by those who practice it, it is a sedative and produces a state of languor or repose. That is instead of stimulating thought and mental activity, it has the reverse effect. Now the purpose of meetings, such as has been referred to, should be to stimulate thought, and thus excite discussion and not repress it. Any careful observer can see at such meetings that just as soon as cigars are distributed, and the audience is converted into a fumous body, that interest in the subject before the meeting is lessened, discussion lags and attention is diverted. When a man converts his mouth to the uses of a smoke-stack he consciously or unconsciously loses much of the gift of discussion. It is not quite certain what substances can and what cannot be penetrated by the Röntgen X rays that we have heard so much about lately, but it may safely be assu[illegible] .It for any one either to absorb or conv[illegible] nd thought, which must penetrate th[illegible] acco-smoke, in passing from the speake[illegible] oking detracts much from the dignity [illegible] it lessen the interest in the subjects u[illegible] it blunts the perceptions of the audien[illegible] it ought to be the main object in comin[illegible] herefore, moved, in the words of Mr A[illegible] this time forth we have no more smoki[illegible] s."

Personal.

Mr. Henry McHarg has been elected President of the Texas Central.

Mr. M. C. Grace has resigned the position of Master Mechanic of the Monterey Mineral & Terminal Railway.

Mr. P. Maher has been appointed Master Mechanic of the Indiana, Illinois & Iowa Railway, vice Mr. L.H. Miller, resigned.

Mr. John Purcell has been made Assistant Master Mechanic of the Atchison, Topeka & Santa Fe at Argentine, Kan., in place of Mr. J. Forster, promoted.

Mr. John K. Cowen, President, and Mr. Oscar G. Murray, First Vice-President of the Baltimore & Ohio, were on Feb. 29 appointed receivers of that road.

Mr. H. G. Bowles, General Manager of the Monongahela River Railroad, has been appointed General Superintendent, and Mr. J. A. Feckinger succeeds him as General Manager.

Mr. W. A. Mills, Assistant to the late President of the Columbus, Hocking Valley and Toledo road, has been appointed General Manager of that road, with headquarters at Toledo.

Mr. Merle Middleton has resigned the position of Western Manager of the Safety Car Heating & Lighting Company to become associated with the Standard Steel Works of Philadelphia.

Mr. Hiram S. Cable, son of Mr. R. R. Cable, President of the Chicago, Rock Island & Pacific, has been appointed to the position of Vice-President and General Manager of the Rock Island & Peoria.

Mr. E. L. Chapman has been appointed Assistant Superintendent of Motive Power of the Southern Railway, to succeed Mr. Thomas, who, as noted last month, was promoted to the head of the department.

Mr. C. B. Hart, for several years a Traveling Freight Agent for Chicago, Rock Island & Pacific, has resigned, and will become General Manager of the Hutchison & Southern, a line of 80 miles in Southern Kansas.

Mr. Wm. Taussig has resigned the presidency of the St. Louis Terminal Association because of ill health, and is succeeded by Mr. J. S. Walsh, formerly Vice-President. Mr. E. P. Bryan, General Manager becomes Vice-President.

Mr. Theodore Klein, now General Superintendent of the Central of Georgia, will on May 1st, take the position of General Manager of the Inter-Oceanic Railway, of Mexico. Mr. Klein was formerly on the Mexican National Railway.

Mr. T. E. Adams, Master Mechanic of the Northern Division of the Great Northern Railway Line, has been appointed Superintendent of the Dakota Division of that road, and Mr. T. E. Cramer has been appointed Master Mechanic in his place.

Mr. T. W. Demorest has been transferred from the position of Assistant Engineer in the Motive Power Department of the Pennsylvania lines at Columbus, O., to be Assistant Master Mechanic at the Indianapolis shops of the company.

Mr. William J. Morden, recently the head of the Morden Frog & Crossing Works, died at his home in Chicago last month. The plant of the company in which he was so prominent was started about 1880 at Chicago. The present large plant at South Chicago was erected in 1884.

Mr. Joseph B. Stewart has been appointed to succeed Mr. Wm G. Wattson, deceased, as Superintendent of the Hudson River division of the West Shore Railway, and Superintendent of the Wallkill Valley and Jersey Junction roads. Mr. Stewart was formerly Superintendent of Telegraph and Signals.

Mr. E. Dawson has been appointed General Master Mechanic of the Kansas City, Pittsburgh & Gulf Railway, with headquarters at Pittsburgh, Kan. Mr. Dawson was formerly Superintendent of Machinery of the Des Moines & Kansas City Railway, which position he resigned to accept the appointment mentioned.

The death of Mr. N. J. Paradise has resulted in several changes in the mechanical department of the Burlington system. Mr. F. A. Chase has been made Master Mechanic of all the Missouri lines, with headquarters at St. Joseph, Mo., and Mr. L. N. Wilbur has been appointed Division Master Mechanic at Hannibal, to succeed Mr. Paradise.

Mr. Charles G. Waldo, General Superintendent of the Cincinnati, Hamilton & Dayton, succeeds Mr. Wm. M. Greene as General Manager of that road. Mr. Waldo was formerly on the Michigan Central and went to the Cincinnati, Hamilton & Dayton in 1889 as Purchasing Agent. He was then promoted to Assistant to the President, General Superintendent, and now is made Manager of the road.

Mr. Robert B. Campbell, General Manager of the Baltimore & Ohio Railroad, has resigned and has been succeeded by Mr. William M. Greene. Mr. Campbell went to the Baltimore & Ohio in 1892, and became General Superintendent of the Trans-Ohio Division. He became General Manager in 1893. His successor, Mr. Greene, was formerly General Manager of the Cincinnati, Hamilton & Dayton Railway.

Mr. George B. Hazlehurst has resigned the position of General Superintendent of Motive Power of the Baltimore & Ohio Railroad, which he has held since 1891. He entered the Baltimore & Ohio service when a boy, serving first as a clerk, and afterward with surveying parties, until he became assistant surveyor. He was later transferred to the bridge department, where he remained until made superintendent of motive power.

Mr. W. H. Canniff has been appointed General Manager of the Lake Shore & Michigan Southern, and Mr. P. S. Blodgett, General Superintendent. Mr. Canniff has been General Superintendent since 1890, and was previously Division Superintendent on the Lake Shore for many years. Mr. Blodgett had also been a Division Superintendent of the Lake Shore for years, until 1892, when he was made Assistant General Superintendent.

George H. Nettleton, President and General Manager of the Kansas City, Fort Scott & Memphis Railroad, died of paralysis in Kansas City, Mo., March 26. Mr. Nettleton was one of the best known railroad men in the West, and was 65 years old. He was born in Chicopee Falls, Mass., Nov. 13, 1831, and first entered the railroad service on March 7, 1851, as rodman on the New Haven & New London Railroad, of Connecticut, which afterward formed a part of the shore line of the New York, New Haven & Hartford Railroad.

Mr. Harvey Middleton, recently Superintendent of Construction at the Pullman works of the Pullman Palace Car Company, has been appointed General Superintendent of Motive Power of the Baltimore & Ohio Railroad. Mr. Middleton was appointed superintendent of machinery on the Louisville & Nashville in 1884. Five years later he went to the Atchison, Topeka & Santa Fe, and shortly afterward became superintendent of motive power and machinery of the Union Pacific, which position he held until he went with the Pullman Company.

James H. Stewart, formerly General Manager of the Cincinnati, Washington & Baltimore, was found dead in his room at Sandusky, March 15, having been suffocated by natural gas escaping from a stove. Mr. Stewart was born at Rochester, N. Y., May 8, 1827, and began railway work in 1848, on the Rochester & Niagara Falls road. From 1853 to 1858 he was superintendent of construction on the Wabash, and for the next nine years was General Superintendent of the Sandusky, Mansfield & Newark. From 1867 until 1874 he was General Superintendent of the Winona & St. Peter. He was General Manager of the Cincinnati, Lafayette & Chicago from 1875 to July, 1879, and was General Manager of the Marietta & Cincinnati from 1879 to 1881. In 1883 he was made General Manager of the Cincinnati, Washington & Baltimore, which position he held until Jan. 1, 1890. He was active in the construction of the Sandusky & Hocking, and was a director of that company.

William A. Parry, son of Charles T. Parry, late of the Baldwin Locomotive Works, of Philadelphia, died in British India on February 8. Mr. Parry was left a large estate. He was 35 years old, and started in October last for a tour of the world. He had reached the base of Mount Everett, near Calcutta, when he died. His friends in this country have not yet learned the cause of his death. Mr. Parry was owner of the schooner yacht *Telfer*. He was a member of the New York Yacht Club and one of the founders of the Corinthian Yacht Club of Philadelphia, of which he was for a time vice-commodore. He was also a member of the Bachelors' Barge Club, Union League and Art Club in Philadelphia, and a member of the Colonial Club, of New York. He leaves a wife and one child. The body is on its way home, and will be buried in Philadelphia.

William G. Wattson.

Mr. William G. Wattson, Superintendent of the Hudson River Division of the West Shore Railroad, died on March 10 from the effects of wounds received March 5, at the hands of a discharged employee. Edmund Clifford, who had been employed by the road as a detective, was discharged for drunkenness, and went to Mr. Wattson's office, while under the influence of liquor, to complain of his discharge. After a brief parley he drew a pistol and fired at Mr. Wattson several times, the second shot wounding him fatally.

Mr. Wattson was the son of a clergyman, and was born in Prince George County, Maryland, in 1851. He entered railroad service as a telegraph operator, and served as operator, station agent, dispatcher, etc., on the Queen Anne & Kent County, Huntingdon & Broad Top and Allegheny Valley Railroads. He entered the service of the West Shore in 1883, and for several years was car accountant. He became superintendent in 1890. He took an active interest in the work of the Car Accountants' Association, American Railway Association, American Society of Railroad Superintendents, the New York Railroad Club and other societies. He occupied the office of secretary of the latter society at the time of his death. He was an energetic worker, and widely known and respected in railroad circles. He leaves a wife and three daughters.

Nathaniel W. Pratt.

Through the announcements in the daily papers most of our readers will have learned before this notice reaches them of the death of Nathaniel W. Pratt, President of the Babcock & Wilcox Company, which occurred on March 10, at his home, in Brooklyn, N. Y.

He was descended from old New England ancestry, who on both his father's and mother's side settled in Plymouth County, Mass., in 1630, although he was born in Baltimore in 1852, and was therefore, 44 years of age at the time of his death.

He inherited from his father—who during the war was superintendent of the Burnside armories in Providence, R. I.—an aptitude for mechanics, and in 1870 he entered the employ of the firm of Babcock & Wilcox, who were then manufacturing boilers and engines. Through his energy and remarkable business qualifications he soon gained the confidence of his employers. In 1881 the firm was organized into a corporation, and he was then appointed Treasurer and Manager of it. He filled these positions until 1893, when, on the death of Mr. Geo. H. Babcock, one of the founders of the original firm, he was elected President of the company which position he held until the time of his death.

He had the rare characteristic of combining engineering and inventive ability with remarkable capacity for conducting business affairs, and it was to his exertions largely that the remarkable success of this company was due. In 1884 he became consulting engineer to the Dynamite Gun Company, and it was from his designs and under his patents that the first successful dynamite gun, which was of 8-inch caliber and 60 feet long, was built, and it was with it that the experiments at Fort Lafayette, in New York harbor, were made in throwing torpedoes.

He was for 25 years associated with the Babcock & Wilcox Company and firm, and the growth of that establishment and the success of its business was largely due to his business sagacity and sound judgment, and it now occupies the position of being one of the largest boiler manufacturing companies in the world, and it is to it that the success of water tube boilers is largely due. Mr. Pratt was energetic and aggressive in the conduct of business affairs, but also had the reputation of being generous and of a kindly disposition towards those less favored by fortune than he was.

He was a member of the American Society of Mechanical Engineers, the American Institute of Mining Engineers, American Naval Institute, and of the Engineers' Club of New York. His aged father and mother, his wife and three children survive him.

Notes.

An accurate measurement of coal consumption and horse power of a 22 and 40 by 48-inch, Reynolds Corliss condensing engine for three years shows that in 1893 an average of 381 horse power was obtained on 1.70 pounds of coal per horse power per hour, in 1894 an average of 393 horse power at, 1.67, and in 1895 an average of 396 at 1.65 pounds. The engine and boilers, which were also of the Reynolds type, were at the Stevens Linen Works at Webster, Mass. The owners of the plant obtained the figures, and they state that they indicated the engine morning and afternoon and carefully weighed all coal.

A section of a combined parlor and sleeping car from the designs of L. F. Ruth has been recently constructed at the shops of the Pittsburg and Lake Erie Railroad. Pneumatic cushions are used for berths and chairs and the berths are stored in casings on the sides of the car which do not interfere with light or ventilation. The collapsed mattresses occupy but little space and when the berths are made up the parlor chairs are stored between the floor and the lower mattress, being removed from their bases which are large enough to contain the bedding.

Four pumping engines each of 20,000,000 gallons daily capacity have recently been built by the Southwark Foundry & Machine Company for the city of Philadelphia. The engines are of the verticle, triple-expansion type and have cylinders 37, 62, and 96 inches in diameter, and three single acting pump plungers 34½ inches in diameter, all of 54-inch stroke. The total weight of each engine proper is about 1,000,000 pounds, or 2,000 tons, for the four engines, and the pumps and their attachments add 2,500 tons to this amount. A noteworthy feature of this pumping plant is the substitution of steel structural work in place of the usual cumbersome and expensive masonry work for the support of the engines. This construction gives easy access to all parts of the water end for examination, and in case of necessity the pump chambers can be removed and replaced with but little work. The Southwark Foundry has been the first to use this method of construction for supporting engines and had found it to be perfectly rigid. The engines described have run noiselessly and with little vibration, and there is every reason to suppose that the supports will be as rigid as a masonry foundation. The plant was fully described in a paper by Mr. T. H. Mirkil, Jr., before the Engineers' Club of Philadelphia.

From a circular recently issued by the Forestry Division of the Department of Agriculture it appears that careful estimates place the forest area of the United States (exclusive of Alaska) at about 500,000,000 acres, and that there are standing ready for the ax a total of 2,300,000,000,000 feet, board measure, of lumber of all kinds. The annual cut is 40,000,000,000 feet. Adding the consumption for fuel, fence material, waste in the woods and at the mills brings the total annual wood consumption of the country up to 25,000,000,000 cubic feet, or about 50 cubic feet per acre of forest, which is equivalent to the yield per acre realized in the well-kept forests of Prussia, where reproduction is secured by skillful management.

Mr. F. H. Stark, master car builder of the Cleveland Lorain & Wheeling, informs us that he has substituted metal head lining in place of cloth in some of the road's old passenger cars. Suitable designs can be found such as are used for small rooms, with raised work not too bold and quite appropriate for coach headlining. As a rule, stamping works make the sections in squares 2 ft. by 2 ft., but he got the last lot in sections 2 ft. by 8 ft. They are secured to the ceiling with lap joints without battons. He thinks there is a possibility of some trouble with joints opening after a while so as to be noticeable. He paints the lining a drab color that will not show the effect of smoke and yet make the car light. This is quite a departure in the way of color, but it has a good effect. The cost is so reasonable and the work so permanent that it is worthy of consideration on the part of those seeking economy.

The North of England correspondent of *The Engineer* writes to that paper:

"A new departure in marine engineering has been made at West Hartlepool, where the *Inchmona*, a new screw steamer, is to be fitted with the first set of Mudd's patent five-cylinder and four-crank engines, with boilers working at a pressure of 255 pounds per square inch under induced draught. Mr. Thomas Mudd, the inventor, is the Mayor of Hartlepool, and is the managing director of the Central Marine Engine Works, which will supply the engines. The object of the invention is to obtain a greater economy of fuel than has been possible with the triple-expansion engine. It is little more than thirty years since the introduction of the compound engine with a boiler pressure of 65 pounds."

The *Engineer* is authority for the statement that the cogwheel and rack railways of the world include 70 lines built since 1812; and of these 17 are in Switzerland, 14 in Germany, 12 in Austria-Hungary, 4 in France and 3 in Italy, the others being in England, Spain, Greece, Portugal, the United States, South America, Asia and Australia. The total length of these lines is 500 miles, of which 188 are of the Abt system. These lines are worked by 300 locomotives, the heaviest of which weighs 70 tons.

The committee on the supervision of the standards and recommended practice of the Master Car Builders' Association will be glad to receive suggestions in reference to any such modifications of the established standards and recommended practices of the association as are justified by experience in their use. Members believing changes or additions should be made to any of these standards should communicate with Mr. R. H. Soule, chairman, Roanoke, Va.

The committee of the Master Mechanics' Association that is to report on "What kind of grate is most suitable for burning anthracite coal—cast-iron shaking or water bar?" has issued a circular of inquiry containing 35 questions. We have not the space to publish this important circular, but the members having information on this subject can render good service to the committee and the association by sending answers to the questions to Mr. Ed. L. Coster, 10 Wall street, New York City.

The latest schedule of the Philadelphia & Reading railroad shows that a new train has been put on that makes the trip from Philadelphia to New York in 1 hour and 45 minutes, or 15 minutes shorter than the fastest previous schedule. The train has three vestibuled cars weighing about 100 tons, and is hauled by a Vauclain compound locomotive with a single pair of drivers 84½ inches in diameter. The engine has a leading four-wheeled truck with 36-inch wheels, and a pair of trailing wheels under the firebox that are 54½ inches in diameter. The cylinders are 13 and 22 inches in diameter and 26 inches stroke. The boiler has 1,400 square feet of heating surface and carries a pressure of 200 pounds. The weight on the drivers is 48,000 pounds and the total weight of the engine is 110,500 pounds. The train leaves Philadelphia at 8:20 a. m. and arrives at Jersey City, 90.2 miles, at 9:53, making two stops, and averaging 58.2 miles per hour. The time for one stretch of 75½ miles is 70 minutes, or 64.7 miles per hour. Westbound the time is five minutes slower.

It has been found by several of the prominent roads entering Chicago that the boring of locomotive tires need not be the expensive and lengthy job it is usually found to be. By increasing the feed, and if necessary, using water on the tools to keep them cool, the work can be greatly accelerated. A 50-inch tire can be bored in less than an hour and where one man has more than one machine to operate the cost of boring a tire of this size need not cost the company more than 25 cents. The larger tires cost proportionately more.

The trustees of the New York and Brooklyn Bridge, at a meeting held March 23, adopted the report of Superintendent Martin recommending that electric motors be used for switching trains at the terminals. It is expected that twenty cars will be equipped with motors, each car being provided with four of 62½ horse-power each. This will give a maximum drawbar pull of 6,400 pounds. These motors are expected to haul trains over the bridge in the early morning hours, or at other times should the cable fail. The Superintendent was instructed to prepare plans and specifications for the installation, and to advertise for bids for electric heaters for these cars. The cost of the power house and the machinery is estimated at $300,000. The Executive Committee of the trustees recommends that the contract for the motors be awarded to the General Electric Company on its bid of $3,645 a car.

Economical Designing of Timber Trestle Bridges.

Bulletin No. 12 of the timber physics series being issued by the United States Department of Agriculture contains an article under the above caption from the pen of A. L. Johnson, C. E., with several letters of comment upon it from prominent engineers. The article begins by showing that there are 2,000 miles of timber trestle in this country costing more than $60,000,000 and requiring replacement, on an average, every nine years. The need of economy in the design is thus apparent. Data from the present practice of railroads shows that there is no uniformity in design, the factor of safety in beams running from 1.5 to 13, and the factor for endwise crushing ranging from 2.6 to 25. Other irregularities in present practice are shown, and then under the head of "Recommended Practice" the author says:

Since the strength of timber varies very greatly with the moisture contents (see Bulletin 8 of the Forestry Division), the economical designing of such structures will necessitate their being separated into groups according to the maximum moisture contents in use

MOISTURE CLASSIFICATION.*

CLASS A (moisture contents, 18 per cent.).—Structures freely exposed to the weather, such as railway trestles, uncovered bridges, etc.

CLASS B (moisture contents, 15 per cent.).—Structures under roof but without side shelter, freely exposed to outside air, but protected from rain, such as roof trusses of open shops and sheds, covered bridges over streams, etc.

CLASS C (moisture contents, 12 per cent.).—Structures in buildings unheated, but more or less protected from outside air, such as roof trusses or barns, inclosed shops and sheds, etc.

CLASS D (moisture contents, 10 per cent.).—Structures in buildings at all times protected from the outside air, heated in the winter, such as roof trusses in houses, halls, churches, etc.

The following tables of safe loads have all been made out for Class A, with the intention of making them applicable to bridge trestle construction. To make these applicable to the other classes make the following modifications:

For longleaf pine add to all the values given in the tables, except those for moduli of elasticity, tension and shearing, for Class B, 15 per cent.; for Class C, 40 per cent., and for Class D, 55 per cent. For the other species add to these values, for Class B, 8 per cent.; for Class C, 18 per cent., and for Class D, 25 per cent.

For the modulus of elasticity add only one-half of the above percentages. For tension and shearing use the tabular values—whatever the percentage of moisture.

For longleaf and shortleaf pine these modifications are quite correct, the percentage of increase of strength of the former being about twice as great as that for the latter between the green and dry conditions. This percentage of increase is not so well known for the other species, but tests that have been made indicate a percentage of increase at least as large as for shortleaf pine. Until further tests have been made, therefore, the modifications given above may safely be used.

*The reductions for moisture as given above in the case of longleaf pine appear somewhat at variance with results obtained since; in the case of other species they rest on assumption, for which experimental data are still largely lacking; it will, therefore, be proper to use the same with caution.

The moisture condition at 18 per cent. is one difficult to obtain under natural conditions; it would, therefore, have been more desirable if the author had started from the green condition, which is fixed. The following values for green condition are here added for the four Southern pines, on which alone the Forestry Division has reliable data.

	Moisture condition.	Cuban pine.	Longleaf.	Loblolly.	Shortleaf.	Average change.
	Per cent.					
Transverse strength or modulus of rupture, green	33	6,150	6,200	5,830	5,230	
Compression endwise, green	33	4,150	3,600	3,130	3,400	
Relative strength as a mean of transverse and compression:						
Green	33	100	100	100	100	100
Half dry	20	125	130	122	120	122
Yard dry	15	149	148	117	138	146
Room dry	10	162	194	187	165	182

B. E. FERNOW.

SAFE UNIT STRESSES.

TABLE IV.—*Safe unit stresses of 18 per cent. moisture.*

[The values marked "D" were obtained from experiments made by the Forestry Division. The other values were obtained from various sources, chiefly the Tenth Census report, but so modified, as to give results comparable with Forestry Division values. To arrive at true average values of strength, multiply safe loads by factor of safety given in each column. The values for resilience and tensile strength are the *ultimate* values. The former is practically never used in designing. The latter is a factor impossible to develop in practice, since the piece will always fail in some other way, usually by shearing. (See descriptive text.)]

Species.	Modulus of strength at rupture per square inch.	Modulus of elasticity per square inch.	Elastic resilience per cubic inch.	Crushing strength endwise per square inch.	Crushing strength across the grain per square inch	Tensile strength per square inch.	Shearing strength per square inch.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Longleaf pine (*Pinus palustris*), D	1,550	720,000	1.30	1,000	215	12,000	125
Shortleaf pine (*Pinus echinata*), D	1,300	600,000	1.30	810	215	9,000	100
White pine (*Pinus strobus*)	880	435,000	1.00	700	147	7,000	75
Norway pine (*Pinus resinosa*)	1,090	568,000	......	760	143	......	......
Colorado pine (*Pinus ponderosa*)	980	444,000	......	630	180	......	......
Douglas fir (*Pseudotsuga douglasii*)	1,320	690,000		880	167	......	......
Redwood (*Sequoia sempervirens*)	1,410	226,000	......	650	115	......	......
Red cedar (*Juniperus virginiana*)	1,000	335,000	......	700	250	......	......
Bald cypress (*Taxodium distichum*), D	1,000	150,000	1.10	675	120	6,000	60
White oak (*Quercus alba*), D	1,200	550,000	1.25	800	400	10,000	200
Factor of safety	5	2	1	5	3	1	4

Table IV. is a table of safe unit stresses† of the various kinds for the materials employed in the construction of timber trestles. The "safe unit stress" is equal to the ultimate strength, as determined from the test, divided by a quantity which is called the factor of safety.

In designing add one half inch to each dimension obtained by use of above table to allow for weathering.

The values marked "D" in the table are considered quite reliable, especially those for longleaf and shortleaf pine. These are for a moisture of 18 per cent., representing a half dry condition, and were taken from a minimum moisture curve which represented the average strength of the lowest 10 per cent. of the non-defective pieces tested. This curve gives values from 15 to 20 per cent. less than the mean values obtained for the species, and material of this strength can readily be obtained even for full-sized beams and columns by an inspector of average intelligence.

The other values were obtained from various sources, chief of which was the Tenth Census report.

The information for these species is very meager, but the values given are considered safe, though probably not as economical as they might be if more extensive tests had been made.

As will be seen from an inspection of Table IV., the factor of safety is not a constant quantity, but ranges from 2 to 5. In general, any composite structure should be of equal strength in all of its parts. This does not mean that they should all have the same factor of safety.

The values given for the modulus of elasticity for all the species except redwood and cedar will give, for the average conditions, a deflection equal to about one two-hundredths of the span, which has been assumed as the maximum allowable. This is about equal to a factor of safety of 5 on the total deflection at rupture. The exceptions to this are the two species above mentioned, but these are not used for beams.

The crushing strength across the grain in Table IV. is based upon a crushing of 3 per cent. of the cross-sectional height of the piece. This point may be compared to the elastic limit in the cross-breaking tests. While absolute failure does not occur at this point, yet it is a point beyond which it is unsafe to go. The point of absolute failure in this test is, more or less, an imaginary point, and the above percentage of crushing has been selected as an arbitrary representative thereof. As failure does not occur here, however, a factor of safety of 3 is deemed necessary and sufficient for this kind of a load.

INSPECTION.

Scientific inspection of timber requires a knowledge of the elements affecting the strength thereof.

The following are the principal elements: Moisture condition; weight per cubic foot; size of piece; position in tree; defects, such as knots, cross-graining, ring shakes and season checks; anatomical structure: character of the secretions, such as resin, etc.; method of treatment previous to use.

Moisture condition.—This is the chief element affecting the strength of timber. The strength of a thoroughly seasoned piece is from 50 to 100 per cent. more than that of a green piece. To say that a certain piece of timber has a strength of a certain amount is of no service whatever in determining its relative strength unless the moisture condition is specified.

Weight.—In material of the same species, having practically the same anatomical structure and character of secretions, the strength varies directly as the weight for the same condition of moisture.

Size of piece.—This has some effect, but it is much less than has been generally supposed. The chief difficulty is in the seasoning of large pieces. If this is done carefully no allowance need be made in the safe loads given on account of size, except for more frequent defects.

Position in tree.—The strength varies with the position in tree. In old trees of pine, from 150 to 200 years of age, the strongest portion of the butt log will be at about one-half the radius from the center. As we go higher in the tree, the central part, though weaker than in the butt log, becomes the strongest portion of the cross-section.

Defects.—Large knots should not be allowed to come at the middle of a beam, either on top or bottom, as they are a source of weakness in compression as well as in tension, though not quite to the same extent. The fibers around a knot run nearly at right angles to the axis of the tree, so that in a compression test these fibers are subject to a crushing strength across the grain, in which direction they are very weak.

Season cracks on top of a beam have little effect upon the strength, except as they may collect water and start rot. Those, however, on the side of a beam near the neutral plane, which for timber is usually a little below the middle, are very injurious, as they greatly increase the liability to shear along this plane.

Wooden beams, as ordinarily employed, are more apt to fail in this manner than in any other way. By putting a

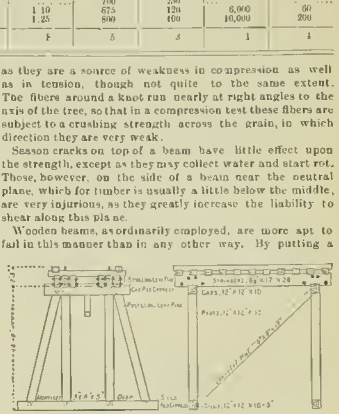


Fig. 1. Present Practice.

bolt in each end of large beams, thus firmly holding the top and bottom portions together, this danger could be largely avoided. Ring shakes are also prime causes of shearing along the neutral plane.

Anatomical Structure.—This has, of course, great influence upon the strength of timber, and to it is largely due the difference in strength between the different species.

But little is known about this subject as yet, except in a general way, as, for example, regarding pine and oak.

The present time is a little premature for the formulation of full rules for scientific inspection of timber. We only know that for strength we require dry timber, and for a given species the heavier the stronger.

For the present it is impossible to evaluate the effect of knots and other defects, but we should guard against them as far as possible.

The safe loads given in the tables herein will then be perfectly safe, and apply to all sizes.

METHODS OF DESIGNING.

PRESENT PRACTICE.

Many of the railroad companies now use a safe load of 1,000 pounds per square inch for the modulus of rupture for longleaf-pine stringers. The caps, sills, and posts are usually 12 by 12 inches, irrespective of load.

Fig. 1 represents a common type of construction designed by the above considerations and for the following con-

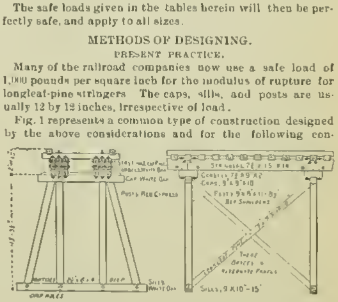


Fig. 2. Recommended Practice With Corbels.

ditions: Span 14 – 14 feet; length post = 12 feet; posts, caps, and sills, all 12 inches square. Load = 100-ton consolidation engine of the P. R. R. Maximum moment = 98,000 foot-pounds on one rail; maximum shear = 30,000 pounds on one rail: maximum bent load = 91,800 pounds on both rails.

The formula for bending is

$$M = \frac{R\,b\,h^2}{6}$$

M = bending moment in pounds per square inch.

R = safe load on extreme fiber in pounds per square inch

b = breadth of beam in inches,

h = height of beam in inches.

Substituting the values for these quantities, we find there will be required three stringers under each rail, 8½ by 17 inches in cross-section, posts, caps, and sills all being 12 by 12 inches in cross section.

The following factors of safety are indicated by their practice.

Stringers in cross-breaking	7.6
Stringers in deflection $\frac{1}{200}$ span	3.1
Stringers in bearing value	2.7
Cap, bearing value under stringers	1.5
Cap bearing value under posts	1.9
Posts, crushing endwise	21.0

† From the cross-breaking test are obtained the modulus of strength at rupture (R), the modulus of elasticity (E), and the elastic resilience per cubic inch (r). *The modulus of strength at rupture* is the intensity (in pounds per square inch) of the stress upon the extreme fibers of a beam at the point where, and at the time when rupture begins.

The modulus of elasticity is the ratio of

$$\frac{\text{Unit stress (in pounds per square inch)}}{\text{Unit distortion (expressed as fractional part of length)}}$$

The elastic resilience of a beam is the product of one-half the load into the deflection at the loaded point. For a beam loaded with numerous concentrated loads the resilience is one-half the total sum of each load into the deflection of beam at that point. This quantity is a function of the volume of the beam.

Bill of material for Fig. 2.

TIMBER, EXCLUSIVE OF TIES AND GUARD RAIL.

Species.	Used for—	Size.	Number of feet B. M	Cost per thousand.	Total cost
Longleaf pine	Stringers	6 Pieces, 7¾"×15" · 14' in 14' lengths	815	$11.00	$8.96
White oak	Caps	1 Piece, 9 " × 9" · 10'	68	11 00	.75
Red cypress	Posts	4 Pieces, 9 " × 9" × 13'	351	8.00	2 81
White oak	Sills	1 Piece, 9 "×10"×15'	112	11 00	1.23
Longleaf pine	S. Braces	1 Piece, 9 "× 7" · 18' 6"	76	8.00	.61
White oak	Corbels	6 Pieces, 7¾" · 9" · 2'	58	8 00	16
			1,180		$14.82
		Cost of iron			5 31
		Total cost of panel			$20.13

Bill of material for Fig 3.

TIMBER, EXCLUSIVE OF TIES AND GUARD RAIL.

Species.	Used for—	Size.	Number feet, B. M.	Cost per thousand.	Total cost.
Longleaf pine	Stringers	8 pieces, 7¾" × 14 5" 11' long	982	$10.50	$10.31
White oak	Caps	1 piece, 12" × 12" × 10	120	11.00	1 32
Red cypress	Posts	4 pieces, 9" × 9" × 13'	351	8.00	2.81
White oak	Sills	1 piece, 9" × 10" × 15'	112	11.00	1 23
Longleaf pine	S. braces	1 piece, 7" × 7" · 18' 6"	76	8 00	61
			1,641		$16 28
		Cost of iron			3 17
		Total cost of panel			$19.45

Bill of Material.

TIMBER, EXCLUSIVE OF TIES AND GUARD RAIL.

Species.	Used for—	Size.	Number feet, B. M.	Cost per thousand.	Total cost.
Longleaf pine.	Stringers.	6 pieces, 8¼" × 17" · 14' in 28' lengths	982	$13.00	$12 80
Red cypress.	Caps.	1 piece, 12 × 12" · 10'	120	11.00	1.32
Longleaf pine.	Posts	4 pieces, 12" × 12" × 13' 6"	648	8.00	5.18
Red cypress.	Sills	1 piece, 12" × 12" × 16' 3"	195	11.00	2.11
Longleaf pine.	S. braces.	1 piece, 8" × 8" · 19'	101	8.00	.81
			3,046		$22.25
		Cost of iron			2 86
		Total cost of panel			$25.11

Figs. 2 and 3 show designs recommended by the Forestry Division, that in Fig. 2 being preferred, though slightly more expensive than that in Fig. 3. These diagrams illustrate an

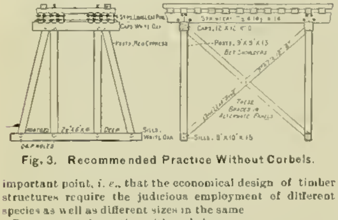


Fig. 3. Recommended Practice Without Corbels.

important point, *i. e.*, that the economical design of timber structures require the judicious employment of different species as well as different sizes in the same

Recommended practice with corbels:

Factors of Safety.

Stringers in cross-breaking	5 +
Stringers in deflection, 1/300 span.	2 +
Stringers in end bearing	1 +
Cap in bearing value	3 +
Posts in endwise crushing	7 4+

Without corbels:

Factors of safety.

Stringers in cross-breaking	5 +
Stringers in deflection 1/300 span.	2 +
Stringers in end bearing	3 +
Cap in bearing value	3 +
Posts in endwise crushing	7 1+

The designs in Figs 2 and 3, though capable of carrying twice as much load as that shown in Fig. 1, show a saving of $5 per span, equal to 36 cents per linear foot of track and 28 per cent. less timber.

Assuming that this would be representative of one-half the total mileage of timber trestle bridges, *i. e.*, 1,000 miles, we have a total saving every nine years of $1,900,000, which is equal to an annual expenditure of $211,000. This capitalized at 4 per cent. gives a capital of $5,275,000. These 1,000 miles of trestle use annually about 120,000,000 feet, B. M., of valuable timber, 35,000,000 of which might readily be saved.

The tables of cost accompanying these designs upon which the above figures have been based are, of course, subject to great modification, depending upon the location, condition of the market, etc. It is thought, however, that they give a fair representation of the average conditions.

Advantages of Raising the Boiler and the Center of Gravity of Engines with a View of Obtaining an Increase in Power and Decrease in the Strain on the Permanent Way.*

The considerations put forward in the following seem to show successfully that the limits at present assigned to the power of express engines rest on somewhat imaginary bases and may be considerably extended. This splendid piece of machinery which has up till now met all requirements has not yet reached its final development and seems capable of meeting still further calls upon it in the future without the necessity of our having recourse to any special device or to new arrangements.

The tendency toward keeping the center of gravity low which for a long time was prevalent among engine manufacturers has undoubtedly helped to retard development. The barrel of the boiler, cramped between the driving wheels could not be made larger; the firebox had no longer sufficient depth if in order to be prolonged backward, it had to lie above a driving or coupled axle and this led to the following recognized disadvantages: imperfect combustion, excessive heating of the tube plates and leakage at the tubes. It was only since what may to-day be called a prejudice was renounced that we have been enabled, by making the boiler to a certain extent independent of the other parts, to place express engines in this respect on the same footing as engines with wheels of small diameter and so markedly to increase their power.

The example it must be acknowledged came from abroad. In England, they were already building what appeared to us very high engines when the Americans, who had till then remained faithful to the classical patterns, decided under the spur of necessity to raise the boilers of their engines right above the wheels and subsequently went much further in this direction than any European builder had dared to go. The highest of these engines (*) hauled one of the fastest trains in the world day after day on lines with but slight superelevation and demonstrated that the utmost limit of stability had not yet been reached. The raising of the center of gravity of engines far beyond what would have been admitted as advisable a few years before was henceforth an accomplished fact and shown to be sound practice; the engineer could henceforth, without fear of trenching on the unknown, have recourse to a method which, while it allowed of engine steam power being increased, also presented special advantages.

The same object had been attained on both sides of the Atlantic by very different means. In England by far the larger proportion of express engines had wheels of large diameter as much as 7.7 feet (2.35 meters) for engines with single driving wheels (†) and internal cylinders. It was accordingly necessary to raise the boiler so as to leave room for the crank axle throws and the connecting rods and at the same time make the motion more easily accessible. In the United States, on the other hand, the cylinders were external and the driving wheels of small diameter. But the great weight of the trains necessitated powerful boilers and accordingly the latter had to be raised sufficiently to allow of the firebox frame being above the frame plate and the barrel of the boiler being above the driving and coupled wheels.

In the Crampton engine the axis of the barrel was situated 5.25 feet (1.605 meters) above the top of the rails, in the Orleans Company's external cylinder express locomotives it was 6.43 feet (1.96 meters), while in the Northern Railway's Outrance type it was 6.92 feet (2.12 meters). Later on this height was increased on some of the French lines and in most express engines recently built the axis of the boiler is between 7.21 feet and 7.47 feet (2.20 and 2.28 meters). We hear, it is true, of engines being designed in which the height is to reach 8.03 feet (2.45 meters). All express engines constructed in England during the last 12 years have been made with the axis of their boilers 7.44 feet (2.27 meters) high as a minimum; if the engines have internal cylinders and single driving wheels, the height usually reaches from 7.61 to 7.87 feet (2.33 to 2.40 meters), and exceptionally even 7.9 feet (2.41 meters) as in the North Eastern express engines. In Belgium, they have reached 7.77 feet (2.37 meters) and in Austria 8.2 feet (2.50 meters) in some engines actually being built. In the United States, the axis of the boiler barrel is at a height of 8.2 feet (2.50 meters) in the engines lately built and very often is as much as 8.52 feet, 8.69 feet (2.60 and 2.65 meters) and even reaches 8.95 feet (2.73 meters).

Some years ago, the New York Central Company adopted a type of express engine the boiler of which is situated just 8.85 feet (2.70 meters) above the rails.

The height nowadays regarded as a minimum in the United States is actually greater than the maximum in Europe.

Fig. 1, which shows diagrammatically on the same scale an express engine of a recognized and serviceable French type and one belonging to an American Company, gives a better idea than mere feet and inches of how far the Americans have gone beyond us in the power and height of their engines.

For comparison's sake, we have brought together in a single diagram Fig. 2 the front views of three classical types of engines: an old Crampton, an express Midland engine (England), and an engine belonging to the New York Central (United States). The English engine is no doubt, very high, but as the driving wheels are of great diameter (7.74 feet = 2.36 meters) the diameter of the barrel of the boiler is smaller than the distance between the tires. The New York Central engine is much higher, and the boiler reaches beyond the top of the driving wheels, the diameter of which is 7.08

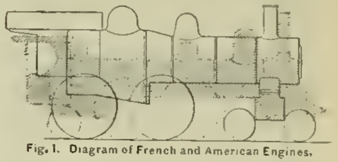


Fig. 1. Diagram of French and American Engines.

feet (2.16 meters). To allow of this engine running on our lines, we should have to cut off part of the chimney and the upper part of the dome. The top of the dome on the firebox is 12.3 feet (3.75 meters) above the rail.

Advantages from Raising the Center of Gravity.—In his work on the locomotive, published in 1877, Mr. Reynolds already stated that "of all express engines running at present the highest provide the greatest security." This assertion is doubtless not an axiom, but still it is in conformity with facts.

When the flanges of the wheels of a locomotive strike the rail on one side under the influence of centrifugal force at a curve, or of movements of oscillation, the engine gives the rail, everything else being equal, a jar which is all the more violent in proportion as its center of gravity is lower. If we suppose the center of gravity to be at the level of the rail, the strain due to the centrifugal force will be entirely transmitted to the rail; if the center of gravity were removed to an infinite distance above the permanent way, the engine would no longer have any stability, and under the influence of an infinitely slight centrifugal force would balance itself on the outer rail, without causing any appreciable strain tending towards displacement. In practice, every engine occupies an intermediate position between these two extreme conditions, but we can already draw the conclusion from the above that the higher an engine is the less will it tend to displace the permanent way. To make it absolutely safe, we

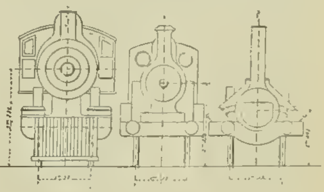


Fig. 2. Front Views of an Old Crampton, an English, and an American Engine.

shall only have to give it the minimum stability consistent with its running no risk of being upset when passing at full speed over curves of the smallest radius which will it have to pass. Now experience shows that this limit is not exceeded by the most lofty American engines.

In this way the more obliquely will it act upon the rail under the action of the transverse strains due to oscillation or centrifugal force. But—and this is the important point—as the engine is hung on springs, the higher its center of gravity the greater will be the proportion of its weight which will bear vertically on its outer wheels. This decreases the tendency toward derailment by loading the outer wheels more heavily and the tendency toward spreading of the gage by the extra weight on the outer rail. Moreover, as the springs come into play this action is felt gradually and without shock, while the strain due to centrifugal force when an engine possesses great stability acts suddenly and violently. The old Crampton engines displaced the permanent way, not so much on account of their long rigid wheel-base as because of their excessive stability.

The transverse movements of the engine on the road, due to oscillation or to centrifugal force, will react upon the flanges of the wheels, on the bearings, boxes and throws of the crank axle, and these reactions will be all the more severe and sudden in proportion as the center of gravity of the whole is lower. If the engine is very high it will roll more and its springs will come into play; at the same time it will not be so hard on the permanent way, and the wear and tear and the chance of the crank axles or boxes giving way will be appreciably less.

Advantages of Raising the Boiler.—In goods engines whose wheels are of small diameter, the barrel may be made of as large a diameter as required, with a view to obtain the necessary heating surface and volume of water, when the firebox is above the trailing axle, it still remains sufficiently low down to avoid the necessity of raising the whole boiler. Such is not the case with express engines, whose wheels are of larger diameter. If the barrel is not sufficiently raised, its diameter is limited to the distance between the tires of the wheels; moreover, if the trailing axle is coupled and goes beneath the firebox, the latter must be much flattened. For instance, with driving wheels 6.56 feet (2 meters) in diameter, if the axis of the boiler is 6.94 feet (2.10 meters) above the rails, the external diameter

(*) We allude to the *New York Central* four coupled engines which haul the *Empire State Express* at an actual speed of 51 miles (82 kilometers) an hour.

(†) This refers to engines with internal cylinders; with external cylinders, the diameter reaches 8.2 feet (2.50 meters).

* Translated from the *Genie Civil* of Nov. 23, 1895, and appearing in the English edition of (*Bulletin of the International Railway Congress*, for Feb. 1896.

of the barrel is limited to 4.26 feet (1.30 meters) when only the necessary play is left between the wheel flange and the boiler. If the axis of the boiler is 8.2 feet (2.50 meters) high the external diameter of the barrel may be increased to 4.92 feet (1.50 meters); if it be increased to 8.52 feet (2.60 meters), the diameter may be increased to 5.41 feet (1.65 meters), which seems more than sufficient for the most powerful express train.

Fig. 3 shows the back view of an American engine with 7.08 feet (2.16 meters) wheels, in which the boiler is situated sufficiently high to enable its diameter to be greater than the gage of the line.

We have shown above that, at any rate within the limits

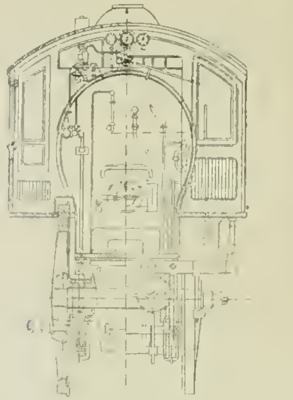


Fig. 3. Rear View of an American Engine.

actually attained, raising the center of gravity seems to offer nothing but advantage, and we have just seen that raising the boiler is necessary if we desire to increase the power of express engines. But we must now show that in raising the boiler the general center of gravity of the engine is raised to a much smaller degree. To imagine that the opposite might be the case implies that we are led away by the apparent volume of the boiler, which in bulk is much the largest part of what goes to make up an engine. Its average density is, however, very small. The weight of the boiler with its water does not, on the average, in a locomotive exceed a quarter of the total weight. Now the center of gravity of the other three-quarters is very low, consisting, as they do, of wheels, frame-plates, cylinders and other parts. Hence the center of gravity of the whole is much lower than one would be inclined to think at first sight, as the following instance will serve to show. Let us take a four-coupled bogie express engine, weighing 48 tons in working order, and having a boiler with a deep fire box, the diameter of the barrel being 4.06 feet (1.24 meters), and that of the wheels 6.56 feet (2 meters). The center of gravity of the parts which carry the weight, make up the mechanism and weigh 36 tons would be about 3.21 feet (0.98 meter) above the rail, the center of gravity of the boiler full of water, weighing twelve tons, would be about .98 foot (0.30 meter) below the axis of the barrel. Accordingly, if the latter is situated 6.88 feet (2.10 meters) above the rails, the center of gravity of the whole will only be 3.74 feet (1.14 meters) above the upper surface of the rails. If the axis of the boiler be 8.2 feet (2.50 meters) above the rails, the center of gravity of the whole would be only 4.06 feet (1.24 meters) high. In other words, as might have been foreseen, in raising the boiler 1.31 foot (0.40 meters) we have only raised the center of gravity of the engine .32 foot (0.10 meter).

Thus in an engine which is higher than any running in Europe—the axis of the barrel being 8.2 feet (2.50 meters) above the rail—the center of gravity for the whole is only 4.06 feet (1.24 meters) high, which is *much lower than the height of the center of gravity of loaded wagons or of the ordinary passenger carriages and all the more of saloon carriages with high and heavy bodies.* There are running on main lines cars whose center of gravity is 4.92 feet (1.50 meters) or more above the rails; in order that the center of gravity of an engine corresponding fairly closely to the description given above, should be equally high, *the axis of the barrel would have to be 10.62 feet (3.24 meters) above the upper level of the rails,* which is much higher than anything yet reached in the latest American engines.

Conclusions.—From what has been said it seems that the following conclusions may without risk be drawn:

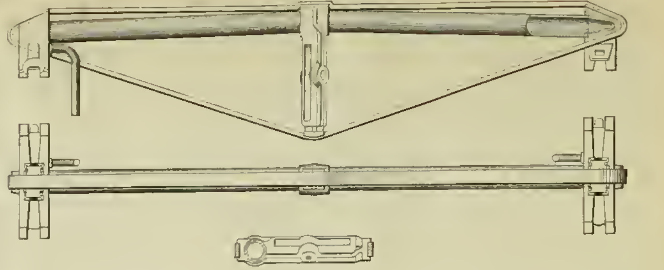
1. Within certain limits, which have so far not been reached in Europe, or even in America, raising the center of gravity of engines has nothing but good results. It results in decrease in the strain on the permanent way and on the parts which go to make up the engine, wheels, axles, boxes and frame plates. The running of the engines is made smoother because the springs come more into play under the action of lateral motion and in running round curves; the tendency to derailment is decreased by the increase of the load on the outer rail when curves are run over at a high rate of speed.

2. Raising the boiler seems to be the most practical, the most simple and the least costly method of increasing engine power, as it allows of the barrel having a diameter greater than the space between the tires.

3. As the boiler does not on the average make up more than about a quarter of the weight of an engine, if it be raised a given amount, the center of gravity of the whole is only raised about a quarter of this amount.

4. The center of gravity of the highest engines in use at present is much lower than that of passenger carriages and loaded wagons; it can therefore be considerably raised without fear of endangering safety.

What has been said above and the tendencies which from day to day become more marked, lead us to think that the future belongs to high engines, and that, cost what it may, we must endeavor to raise the boilers in order to make their power proportionate with the growing requirements of railway working, and with a view to decrease, in proportion as speed increases, the wear and tear on the permanent way.



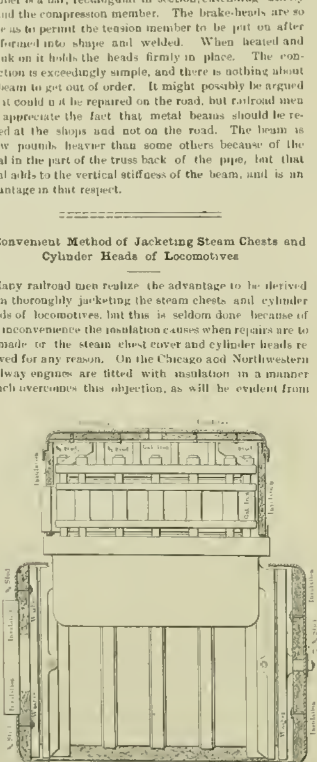
A New Brake-Beam.

A New Brake-Beam.

The accompanying illustration is a new brake-beam designed and patented by Mr. J. N. Barr, Superintendent of Motive Power of the Chicago, Milwaukee & St. Paul Railway. The compression member is of pipe and the tension member is a bar, rectangular in section, extending entirely around the compression member. The brake-heads are so made as to permit the tension member to be put on after it is formed into shape and welded. When heated and shrunk on it holds the heads firmly in place. The construction is exceedingly simple, and there is nothing about the beam to get out of order. It might possibly be argued that it could not be repaired on the road, but railroad men now appreciate the fact that metal beams should be repaired at the shops and not on the road. The beam is a few pounds heavier than some others because of the metal in the part of the truss back of the pipe, but that metal adds to the vertical stiffness of the beam, and is an advantage in that respect.

A Convenient Method of Jacketing Steam Chests and Cylinder Heads of Locomotives.

Many railroad men realize the advantage to be derived from thoroughly jacketing the steam chests and cylinder heads of locomotives, but this is seldom done because of the inconvenience the insulation causes when repairs are to be made or the steam chest cover and cylinder heads removed for any reason. On the Chicago and Northwestern Railway engines are fitted with insulation in a manner which overcomes this objection, as will be evident from



Method of Jacketing Steam Chests and Cylinder Heads—Chicago & Northwestern Railway.

the accompanying illustration. The cylinder head castings have 1½ inches of insulating material (which we understand is asbestos) held to the inside of each by a disk of galvanized iron secured by studs screwed into the casing. Evidently when the casing is removed, the insulation comes with it, and the workman would not know of its presence except for the increased weight of the casing.

The steam chest casing cover is provided with insulating material, secured in place in the same manner. The vertical sides of the casing are made double and the inner and outer sheets flanged toward each other, with the flange of the outer sheet under the other. The space between them is filled with asbestos and when the casing cover is on it is secure. The insulation on the back cylinder head is not so easily removed as that on the front one, but there is seldom occasion to disturb it. This matter of thoroughly jacketing all parts of a locomotive to which the heat of live steam is communicated is worthy of careful attention, for the saving to be effected at small outlay is considerable.

Trade Catalogues.

[In 1891 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

STANDARDS.

For postal-card circulars	3½ inches by 6¼ inches.
Pamphlets and trade catalogues	3½ inches by 6 inches. 6 inches by 9 inches. 9 inches by 12 inches.
Specifications and letter-paper	8½ inches by 10¾ inches.

LEAD LINED IRON PIPE COMPANY. *Manufacturers of Standard Lead Lined Iron Pipe and Fittings.* Wakefield, Mass. Price list No. 16. 16 pages. 5¼ by 8¼. (Not standard size.)

This company manufactures wrought-iron pipes which are lined with lead, the latter intended to resist corrosion, and the outside iron casing giving the requisite strength to resist internal pressure. Lining a pipe with lead is not very difficult, but the company makes all the fittings, couplings, elbows, tees, etc., which are also lead lined, and in such a way that part of the thread for screwing the parts together is cut in the lead and part in the iron. Cuts are given showing sections of the pipes and fittings, with tables of their dimensions.

THE THOMPSON-RYAN DIRECT CURRENT MULTIPOLAR ELECTRIC GENERATOR. *Built by J. H. McEwen Manufacturing Company.* Havemeyer Building, New York. Works: Ridgeway, Pa. 32 pages. 5¾ by 8¾ inches. (Not standard size.)

The frontispiece of this pamphlet is a half-tone engraving made from a wash drawing of the works at Ridgeway, Pa. In the introduction it is said that the company has made arrangements with Prof. Harris J. Ryan, of Cornell University, and Milton E. Thompson, the inventors of the Thompson-Ryan dynamo, for its manufacture. This, it is said, "is replete with novelties," but "has long since passed the experimental stage, as is fully attested by a number of large sized machines now in constant operation under the most trying conditions." They then proceed to give a full description of these machines, and also add interior views of the works where they are made. Following, then, are half-tone illustrations showing generators driven by horizontal direct connected simple and compound and also vertical engines. The details of the generator are also fully explained and some of them illustrated with very excellent half-tone engravings. The full-page engravings all have ornamented borders, which, with the letter-press, are printed in brown ink, the engravings being black. The paper and typography are all of the best.

ILLUSTRATED CATALOGUE AND PRICE LIST OF THE BOSTON GEAR WORKS, 31 Hartford street, Boston, Mass. 40 pages, 5¼ by 8 inches. (Not standard size.)

In this little pamphlet the publishers describe various kinds of small gears suitable for clock-work and very light machinery, and which doubtless will be useful to many of our readers, who, like ourselves, have often not known where such gears could be obtained. The different sizes, styles, etc., are illustrated and described by cuts and tables. "Intermittent gears," universal joint couplings, brass ratchets and pawls, miter, bevel, crown, internal, elliptical and spiral gears, escape wheels, clutches, keys, small pulleys and hangers, chains and chain wheels, cotton worms and worm-gears, are all manufactured by this company and are described in the pamphlet before us. The company also manufacture gears for heavy machinery, but these, it is said, will be described in another catalogue.

NO. 55, PRICE LIST, GALVANIZED STEEL WIRE NETTINGS, WIRE FENCING, WIRE WINDOW AND DOOR SCREENS, ETC. *E. Hu. Will Wire Cloth Company,* 17 Warren Street, New York. 28 pages. 3¼ by 6 inches. (Standard size.)

This company manufactures steel wire netting for various purposes, cable for lightning rods, and fencing wire and ribbon fencing, wire window and door screens, etc., all of which are illustrated and described in the little volume before us the only fault of which is that it is printed in blue ink.

MORRIS MACHINE WORKS. *Builders of Centrifugal Pumping Machinery, Engines and Boilers,* Baldwinsville, N. Y. 32 pages. 6 by 9 inches. (Standard size.)

In the introduction to this catalogue the publishers say that "centrifugal pumps are constantly finding new favor

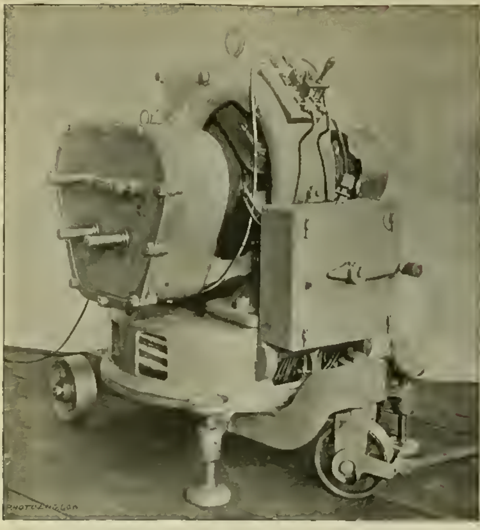


Fig. 1.

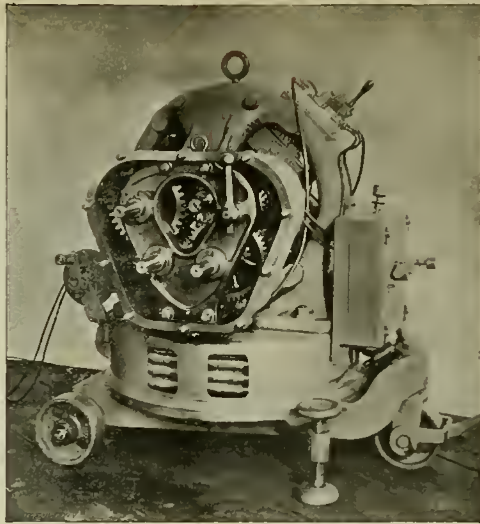


Fig 2.

GIBBS' PORTABLE ELECTRIC MOTOR FOR SHOP USE.

from users, on account of their simplicity, durability, great capacity for handling material in large quantities, capability of pumping muddy and gritty water (which would shortly cut out any piston pump), their great economy of power under low lift and their low cost, which is anywhere from one-third to one-half that of any other type of pump."

In a following article the advantage of having a pump properly proportioned to the work which it must do is set forth and explained. Illustrations are then given of a large sewage pump with a direct connected engine, which is followed by an illustration and description of the different sizes of vertical pumps that is there, the shaft of which is in a vertical position. Several types of pumps, to be driven by belts, are then illustrated and described, and tables of drums of the different sizes are also given. This is followed by a curious diagram showing the position of the suction and discharge pipes of various patterns of pumps, 32 in all. It would hardly seem possible to place these pipes in so many different positions.

A number of illustrations follow, representing direct connected pumps, in which vertical engines are connected direct to the pump shaft. Several hydraulic dredging pumps to be driven by belts, and a portable pumping outfit and various details of these machines are shown.

The wood engravings are all excellent and the typography equally so, and the whole makes a very attractive volume.

The Gibbs Portable Electric Motor for Machine Shop and Round-House Work

In shops where electricity is used for lighting and power purposes, portable electric motors can be used to advantage in the same lines of work that steam and compressed air motors are so frequently employed. In many situations they present superior advantages, because of the ease with which they can be connected to receive power, flexible wire cables taking the place of iron pipes for steam or air, and from the fact that there is no exhaust to be taken care of.

The Gibbs Electric Company, of Milwaukee, Wis., has recently designed and built a number of portable motors for general machine shop work, from photographs of which the accompanying illustrations were made. It is the intention to use these motors with Stow or other flexible shafts for such work as boring cylinders, facing valve seats, drilling staybolts, tapping sheets for staybolts, and general round-house and machine shop work, in which motors can take the place of man power with economy.

Figs. 1 and 2 are both rear views of the motor mounted on a three-wheeled truck, Fig. 1 showing it complete, while in Fig. 2 the cover of the spindle case is removed. The commutator is on the further end of the armature shaft, and the pulley adjacent to it, which can be seen in Fig 1, is used for belting direct to machine tools. Fig. 2, which is taken from a slightly different position, shows at the left a cable reel, on which is wound about 100 ft of cable, allowing the motor to be moved within a radius of about 100 ft. from the supply of current. On the end of the cable is a plug, which can be inserted into sockets at various points in the shop, so that the tools can be taken anywhere and receive power.

The motor is mounted on a round base, which in turn is mounted on the truck proper on a center pin. The round base is in the form of a turn-table, so that the motor can be swung around to suit the work. In this round base is placed the resistance coils, which vary the speed of the motor.

The box, or gear case, containing the drill spindles, is shown in both illustrations, Fig. 2 having the cover removed to show the gearing. The three spindles run at 177, 98 and 40 revolutions respectively. These speeds can, of course, be changed to suit any requirements which it may be necessary to meet. It may be noticed that there is a handle on the spindle box, similar to that used on the back gearing of lathes. When it is desired to use the pulley only, the gearing is by means of this handle thrown out of clutch, and the wear on the same is avoided.

On the right hand side, in both of our figures, is shown the main switch and controlling box with reversing switch. The reversing switch lever is seen projecting through the top of the box, and is interlocked with the controlling lever, so that it is impossible to reverse the motor unless it is first stopped. The resistance coils in the base will vary the speed of the motor from 900 to about 450 revolutions per minute, thus, of course reducing the speed of the spindles proportionately.

When at work the motor is steadied by the two screws bearing on the floor, and the handle for hauling it about the shop can be taken off so as to be out of the way.

Everything about the motor is made on jigs and templets and is interchangeable. The gearing is the best obtainable. All the spindle bearings are exceedingly large, and, as the gears run in oil, perfect lubrication is obtained. The motor is five horse-power, and is sufficiently large to drive any ordinary machine tool found in railroad shops. The spindle running at 177 revolutions is intended for tapping in staybolts, and it has been found that it is possible to run staybolt taps at this speed. The other two speeds are for cylinder boring and valve-seat facing. If it is desired to use the spindles for running-rope drives, a pulley can be put on any one of them, the advantage of this being that the spindles are so reduced in speed that no countershaft is necessary.

The weight of this motor complete is 1,400 pounds, but, on account of its construction, is readily moved about the shop by one man. Everything about the motor, gearing and truck is of the best, and no expense has been spared in making the tool as perfect as possible.

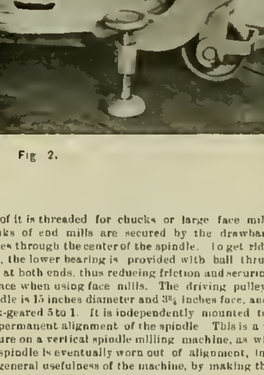
The Becker Vertical-Spindle Milling Machine.

In the accompanying illustration we show an interesting vertical-spindle milling machine made by the John Becker Manufacturing Company, of Fitchburg, Mass. It is claimed for this machine, which is known as No 5, that it is more practical, is of greater adaptability and has more labor-saving qualities than any horizontal spindle mill on the market. As a boring mill it is in many respects superior to the drill press

The frame is heavy and very rigid, and is therefore suitable for heavy cuts. The spindle has long bearings running in bronze boxes that are adjustable for wear. The lower end of it is threaded for chucks or large face mills. The shanks of end mills are secured by the drawbar which passes through the center of the spindle. To get rid of end play, the lower bearing is provided with ball thrust bearings at both ends, thus reducing friction and securing a level surface when using face mills. The driving pulley of the spindle is 15 inches diameter and $3\frac{3}{4}$ inches face, and double back-geared 5 to 1. It is independently mounted to secure the permanent alignment of the spindle This is a valuable feature on a vertical spindle milling machine, as without it the spindle is eventually worn out of alignment, impairing the general usefulness of the machine, by making the use of large surface mills impracticable, for obvious reasons.

The head has a vertical traverse of seven inches automatically and with automatic release. It is provided with a stop gage graduated to thousandth of an inch.

The knee has a vertical adjustment of 18 inches, and the greatest possible distance between table and spindle is 21 inches. The table is 48 by 13 inches (working surface), and has an automatic feed of 40 inches. The saddle, which is the same length as the table, has a cross feed of 13 inches. The



The Becker Milling Machine.

rotary attachment, with an automatic feed in either direction, is found to be an exceedingly useful feature The table is 22 inches in diameter and will swing work 31 inches.

The table has six changes of straight and rotary feed for each change in speed. An arbor support, attached to the knee, is provided for use with long arbors for slab or straddle milling. Gripping jaws, 9 inches by 2 inches, fitting the slots in the table, also accompany the machine

The workmanship and materials are guaranteed to be of the best and no pains are spared to make it a reliable and accurate machine. A glance at the illustration shows it to be a handy and convenient tool for many kinds of work. In drilling and boring work it has a large range and the rotary feed makes it possible to mill out large holes with great accuracy. The machine complete with countershaft weighs about 4,300 pounds.

The success of this tool has been remarkable not only in this country but also abroad. A firm in Budapest, Hungary, are using two of them and has just ordered a third.

The Use of Electricity in the Brooks Locomotive Works.

In 1881 the Brooks Locomotive Works purchased two five-arc light and three 10 arc light dynamos for illuminating its works and from the small beginning thus made, the use of electricity has spread until it is used for light and power in nearly every department of the plant. In 1888 an incandescent light plant was installed, but it was not until 1892 that the current was used for power purposes. Then two power generators were put in service to furnish current for overhead cranes in the boiler shop and foundry, and in 1894 the uses of the current, actual or prospective, were so numerous that it was decided to concentrate the generating plant and a contract was made with the Western Electric Company, for one 200-horse power and one 100-horse power generator. These generators supplanted all other apparatus and now operate 80 arc lamps, 450 incandescent lamps, and furnish electricity for one 35-horse power motor to run shafting in iron foundry; one 30-horse power motor for transfer table; one 25-horse power motor for the bending rolls in the boiler shop; one 10-horse power motor for the shafting in pattern shop; one 6-horse power motor for elevator in iron foundry, two 5 horse power motors for punch and shears in boiler shop, one 40-horse power motor for shafting in boiler shop; one 20-horse power motor for bar iron shears, in blacksmith shop; one 20-ton electric traveling crane in boiler shop and two 10-ton electric travelling cranes in foundry. The larger crane in the boiler shop is equipped with two 20-horse power motors and one 6-horse power motor, and the two smaller cranes are each equipped with two 10-horse power motors and one 6 horse power. There are eight electric motors connected with the foundry, six on the cranes, one running the shafting and fans, and one running the elevator.

The two generators furnish power for all motors, driving shafting and isolated machine tools, also current for all arc and incandescent lamps now in service. The arc lights throughout the plant are wired four in series, thus enabling any group of four lamps to be operated at will.

The electric building is new and attached to the east side of the boiler house. Upon entering it, the first thought is of its spaciousness, neatness and order. It has a granolithic floor and the conduits are covered by iron. The two generators, one 200 horse power and the other 100 horse power, are driven by two Buckeye engines directly connected. The steam pipes are all covered with asbestos and jacketed with Russia iron, with polished brass bands. From the generators the current is conducted through lead-covered cables to a large switch board, through a conduit of brick laid in Portland cement, and covered with cast-iron plates, laid in cement, which renders the conduit watertight. From the switch board the current is distributed throughout the works.

Use of Compressed Air.

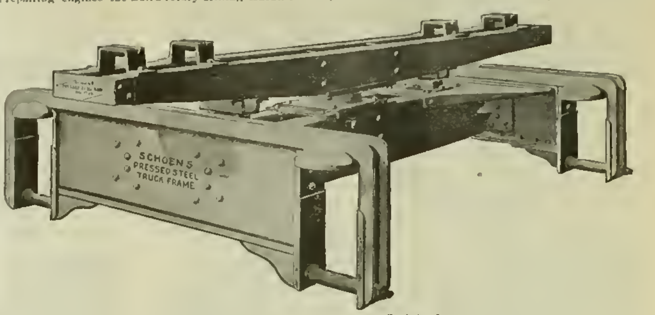
The repair shop of the Atchison, Topeka & Santa Fe at Argentine, Kan., has been fitted up very extensively with pneumatic tools. In the passenger car department the broom and duster and the rattan beater have been thrown away, and the cars are cleaned by the use of compressed air, which is piped through the yard. The laborer simply attaches a hose and turns on the air, and the cars are cleaned much more thoroughly than broom or duster can do it, as the air gets behind every steam pipe and all blinds and ventilators, where it would be impossible to clean by other means. The medical department regards the system the greatest microbe destroyer known.

By the same power wheels are taken from under coaches with a pneumatic jack, a drop pit being used, into which the wheels are dropped. Only the weight of the wheels is handled, instead of the weight of the whole car. At a recent test the middle pair of wheels in a six-wheel truck were exchanged in five minutes and twenty seconds. By the old method this exchange would have required at least two hours' time.

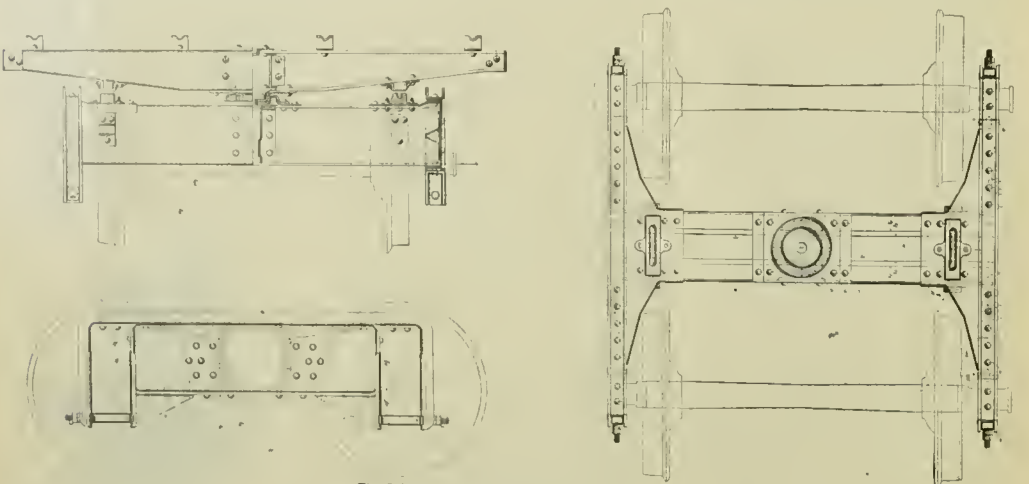
In the round house wheels are taken from locomotives in the same manner, in from thirty to forty-five minutes, a saving of over three hours.

In repairing engines the Baird rotary drilling machine is used, which is worked by the same power. Holes are tapped in a firebox by this method, and flues are rolled and caulked, using a pneumatic hammer which strikes 250 blows a minute, thus doing what was always thought to be impossible—clipping and caulking by other than hand labor. It is but the work of an instant to jack up a freight car, set it on blocking made for the purpose, and take out the truck for repairs. Air pipes are bent in standard shapes by use of air cylinders and dies. Car roofs are torn off by air machines, and car sills are pulled down by an air jack and new ones put back by the same power.

A simple means of delivering oil is in use in the yards. A reservoir close to the oil house is filled with oil, which is forced through underground pipes to any oiling station in the yard in an instant. The pipe is nearly a mile long.—*The Southwest Railway Record.*



The Schoen Pressed Steel Trucks for Freight Cars.



The Schoen Pressed Steel Truck for Freight Cars.

The Schoen Pressed Steel Truck for Freight Cars.

To meet the demand for a more substantial freight car truck, the Schoen pressed Steel Company, of Pittsburg, has brought out a pressed steel truck, shown in outline and prospective in the accompanying illustrations.

The designer started out with the decision to put the springs over the journal boxes, and to make a truck that, besides being reasonable in first cost, will be inexpensive to maintain. The side frame is composed of a top compression member in the form of an inverted channel and a bottom tension member consisting of a bar of 4 by $\frac{5}{8}$ inches iron. Between these there is a pressed steel plate with all of its edges flanged inwardly. These flanges supplement the strength of the compression and tension members. The parts are riveted together with hydraulic power.

The ends of the compression members are turned down to form the outer jaws of the pedestals, and the inner jaw is riveted into place as shown. At the bottom they are held in proper relation to each other by a thimble and heavy bolt provided with two nuts and a split key. The faces of the jaws are protected against wear from the journal boxes by chafing plates. These are thin and light and have a rectangular hole near the bottom which permits them to be fitted over the pedestal bolt. They will last a long time and can be renewed for a few cents.

The transoms are composed of channel-shaped sections placed with the flanges toward each other. They rest on top of the lower flange of the side plates and have their ends stamped outwardly to form brackets by which they are secured to the side plates. The transoms are tied together by vertical braces, and under the center plate is a spacing plate that greatly aids them in resisting transverse strains. To keep the truck square gusset plates extend from the inner jaws of the pedestals to points well out on the transoms.

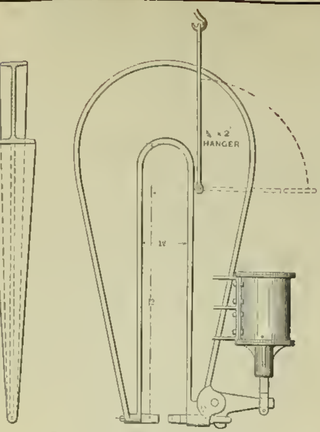
The body bolster shown should really be considered as inseparable from the metal truck, for one of the several advantages of the truck is the stiffness obtainable; but this freedom from deflection, unattainable with a wooden truck bolster, will not keep side bearings entirely out of contact unless there is used in connection with the truck an unyielding body bolster.

There are several advantages for making the side frame of several pieces instead of a single one. In the first place the top and bottom chords of the truss need not be made of the same thickness as the plate, but can be of such sizes and sections as are requisite for strength independently of any considerations of the size or weight of the plate itself. It also facilitates the construction of the pedestals in a substantial but inexpensive manner. Again, it makes it possible to repair the frame in a railroad shop if it has been distorted in an accident, and does not necessitate re-forming the whole side in the original dies with the attendant delays and freight charges.

A few of the claims made for this design are: Increased car mileage, a saving in dead weight; a saving in flange wear on wheels and wear on rails because the truck is kept square; repairs can be made in the railroad shops; a reduction of cost of repairs to a minimum; and the avoidance of such hot boxes as are caused by frames getting out of square. The material is a special grade of mild steel, which the extensive experience of the Schoen Pressed Steel Company has shown to be best adapted for work of this character.

A Pneumatic Riveter for Shipyards.

The Baird Portable Machine Company of Topeka, Kan., are known to many of our readers through the various pneumatic tools built by them and specially adapted for use in railroad shops. But the demand for pneumatic



Pneumatic Riveter for Shipyards.

riveters, punches, etc., is not confined to railroad circles, for the company has just furnished the Chicago Ship Building Company the large riveting machine which we illustrate in the accompanying engraving. It has a 73-inch throat and a 12-inch gap, and has been designed especially for shipyard work.

The air cylinder is about 12 inches in diameter and is mounted on a shelf cast on the frame. It operates through a bell-crank lever fulcrumed on the frame. Instead of pin connections at the ends of the lever, these ends bottom in jaws in the piston rod and riveting plunger, and are held in position during the return stroke by comparatively small pins inserted in the jaws outside of the lever.

The machine is suspended by a hanger, on which it is so balanced as to be easily worked in either the vertical or horizontal positions, or at intermediate angles. This is only one example of the special tools which this company has furnished or is prepared to build for parties whose work is of such a character as to require them.

The Q. & C. Perfection Oil Purifier.

The Q. & C. Company, of Chicago, has recently added to its line of specialties the oil purifier which we show in the accompanying sectional engraving. It consists of a cylindrical casing having a short, open-top cylinder inside of it rivited to the bottom, and a large pan placed inside the casing, and having a central tube extending down from it into the cylindrical shaped vessel at the bottom. This tube carries a bell-shaped vessel which covers the cylindrical one, but without touching it at any point. A cover on top of the casing closes the apparatus. Two gage glasses *A B* and *C D* are provided, also a steam coil which takes steam at 5, a steam pipe with an admission valve 1, and faucets 1, 2, 3 and

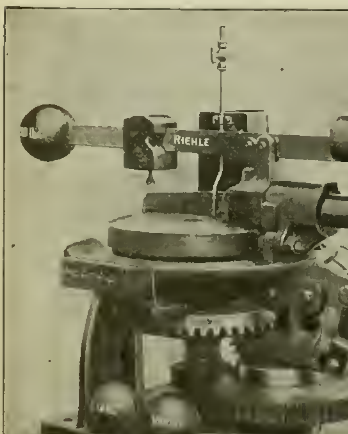
The operation of the purifier is as follows: Water is poured into the upper pan until it rises to within two inches of the top of the lower glass, which point is indicated by the words "water line" in our illustration. Steam is then turned on at valves 4 and 5 until the temperature of the water rises to about 115 or 120 degrees, after which valve 4 is closed and valve 5 regulated to maintain that temperature. Oil to be cleaned is then poured into the pan slowly, and as it descends it is heated and thereby thinned and made to give up much of its impurities, the process of purifying being completed by its passage through the water. Its course is to pass down through the central tube into the water, through which it rises, and then, passing over the top of the cylindrical vessel, goes down between it and the bell-shaped vessel; from thence it is liberated through perforations in the lower flange of the bell and rises through the water a second time to collect on top of it and be drawn off through faucets 6 or 3. In practice the purified oil is kept at about the height shown

The Q & C Perfection Oil Purifier.

in our illustration and when any great quantity is drawn off oil to be cleaned is fed into the pan to take its place.

The purifier does not require cleaning oftener than once in six to twelve months. To clean it, faucet 6 is opened and all the clean oil drawn off, water being poured into the apparatus at the pan to make all of the oil rise to that faucet. Then a full head of steam is turned on at valve 4 and the dirty oil and water will rush out of faucets 1 and 2 when they are opened.

The purifiers have been used long enough to be heartily endorsed by many concerns that have them in service at their shops. They are simple and inexpensive, easily operated, and use a washing medium that does not clog up or waste any of the oil. Only one caution is given, which is to be careful not to overheat the oil, as too much heat makes it thick and spoils it. The purifiers work equally well with all grades of oil and effect a great saving. They are made in 25, 50, 80, 100, 150, 225 and 300 gallon sizes, which have a filtering capacity every 24 hours of 1½, 3, 5, 8, 10, 15 and 20 gallons respectively. From these figures it will be seen that besides acting as filters they afford a large storage capacity. Any special sizes wanted can be furnished at short notice. Further information will be supplied by the Q. & C. Company, Western Union Building, Chicago, Ill.



Riehle Abrasion Testing Machine.

Riehle Abrasion Testing Machine.

The Riehle abrasion testing machine, shown herewith, is an apparatus 25 inches high, 20 inches wide, 34 inches long, and weighs about 350 pounds. It is arranged to take specimens of 1-inch cube or smaller, and can be arranged to take 2-inch cubes also.

The apparatus consists of a revolving disk on a vertical spindle. It is geared three to one, and the disk is fitted with a hardened steel grinding plate. Above this plate a horizontal arm is arranged capable of sliding backward and forward and carrying at one end a 1-inch cube, or other shape, to be subjected to abrasion. This arm also carries a weighted lever or graduated beam capable of loading the abrasion specimen as high as 200 pounds. The spindle of machine is made to revolve by the bevel gears and 10 inch pulleys, as shown, and an extra pair of gears of unequal size give motion by cam and pin to the lever arm, which moves the horizontal arm backward and forward over the grinding disk. The apparatus is also furnished with revolution counter for indicating number of revolutions during test, and with a sandbox and water duct for furnishing grinding material. A brush or scraper may be used to clean the disk if desired. It is intended to run the pulleys at about 150 to 175 revolutions, giving 50 or more revolutions of the grinding disk. It is also intended that the lateral movement combined with the revolution will distribute the wear uniformly over a large part of the surface of the disk. The flange of the main frame is arranged to protect the gearing, and a spout at one part carries off surplus sand and water.

The machine was made for the Cambria Iron Company, and is in use by them at Johnstown, Pa. It was built by Riehle Brothers, Philadelphia, Pa

The Dickerman Twenty-inch Tool Grinder.

The accompanying illustration shows a new 20-inch tool grinder made by the Dickerman Emery Wheel and Machine Company, of Bridgeport, Conn. It is neat and substantial in design, convenient for the operator and confines the water to the right place. The water pan may be quickly drawn through the door in front of the base when it is necessary to clean it, then be placed back in machine and refilled by pouring fresh water into the table, where it will run down into the pan below. The round table in front of the wheel permits the operator to always be at the same convenient distance from the emery wheel, in whatever position he wishes to hold the tool when grinding.

The hood is in one piece except the front, which with the tool rest is adjustable to the wear of the wheel. The emery wheel being encased and with this company's special device inside the hood, water and spray are kept from the emery wheel collars, bearings and floor, and the interior arrangement of the machine is such that no water can get on the floor, inside of the base.

The emery wheel collars are dovetailed and fitted with a device for balancing the wheel. These collars and all other running parts of the machine are turned inside and out, and dust collars are used to keep all water and dirt from

The Dickerman 20-Inch Tool Grinder.

the bearings. This machine being equipped with long self-oiling bearings and a large spindle runs very smoothly. The wheel is 20 inches diameter and 2½ inches or 3 inches face. The diameter of the spindle is 2 inches; the boxes are each 6½ inches long, the spindle pulley 6 inches in diameter and 3½ inches face; the height from the floor to the center of spindle is 36 inches; the foot of base is 20 by 30 inches, and the total floor space occupied is 28 by 35 inches.

Lidgerwood Cableways for the Panama Canal.

Spencer Miller, M. E., engineer of the department of hoisting and conveying machinery of the Lidgerwood Manufacturing Company, New York City, who recently went abroad in the interests of that company, has just closed a contract with the Compagnie Nouvelle Du Canal De Panama at Paris, for seven Lidgerwood cableways, to be used on the Panama Canal. This company is one which has recently been formed to complete the great Panama Canal, and the seven cableways will be used exclusively for earth excavating. They will be equipped with all the latest improvements, including the patent aerial dump, which is such an important feature of these machines, the apparatus throughout being similar in construction to the 20 Lidgerwood cableways used on the Chicago Main Drainage Canal, except that the Panama cableways will have fixed towers and anchorages. The spans will range from 250 to 300 feet.

This order was not placed until after a most careful and extended investigation had been made of the various apparatus available for canal excavating purposes. Engineers were sent by the Compagnie Nouvelle Du Canal De Panama from Paris to examine the Lidgerwood cableways and other excavating machinery in use at Chicago on the canal there building. The result of their investigation was a most flattering report in favor of the Lidgerwood cableways, and the negotiations then begun have resulted in the large order secured by Mr. Miller. This is one of the largest single orders for cableways of any description ever received by any concern in this country from abroad, and points to a world-wide appreciation of the merits of the Lidgerwood cableway.

The Gates Iron Works announce the removal of the downtown office at Chicago to 1112 Masonic Temple.

The general offices of Fairbanks, Morse & Co. in Chicago will, on May 1st, be moved to the northeast corner of Monroe and Franklin streets.

The Chicago office of the Schoen Manufacturing Company, of Pittsburgh, has been moved from the fifth floor to Room 1010 of the Monadnock Block.

The Eastman Fruit Dispatch Company has been organized, with $300,000 capital stock, to manufacture, build, equip, operate, lease and heat refrigerator cars, etc. The general offices are at Jersey City.

The general offices of the United States Metallic Packing Company have been removed to their works, 427 North Thirteenth street, Philadelphia, Pa., and all communications to the company should be addressed to that place.

The United States Wind Engine & Pump Company has sold to the Buffalo & St. Mary's railway two water stations, the tanks for which will be of 60,000 gallons capacity, and will be supported on steel trestles 60 feet high. The wind mills will be each 30 feet in diameter.

The Sterlingworth Supply Company, of 256 Broadway, New York, is erecting a manufacturing plant at Easton, Pa., which it expects to have completed April 1. In the new works there will be ample facilities for the manufacture of the company's various specialties.

The Crane Company, Chicago, has secured the right to manufacture and sell the Mason train signal and Mr. Harry R. Mason, the inventor of the system, has entered the employ of the company. An order has just been obtained to equip 25 engines and 80 cars of the Mexican National Railway with this signal.

The New York Equipment Company, of 80 Broadway, N. Y., is erecting buildings at Dunkirk, Ind., for a large locomotive and car repair shop, and is now in the market for the steam plant and the iron and wood-working machinery requisite for the shop. The plant will be large and complete and the machinery contracts will be large.

The Ontario Car & Truck Company, recently incorporated at Oswego, N. Y., has purchased a site in that place, 125 by 436 feet, and will there erect a large modern plant. The concern will manufacture cars, trucks, ventilators, heaters, seats and brakes. The company possesses a number of patents. Its capital stock is $300,000, of which $100,000 has been paid in.

During one week the Chicago Pneumatic Tool Company recently received orders by mail for two pneumatic hammers from France, three from Russia, four from New Zealand, four from Australia, and one from Austria, besides shipping 10 to London. An additional order of 11 hammers to London received later makes a total of 73 shipped to that city since Dec. 15, 1895.

J. S. Mundy, Newark, N. J., has ready for distribution a pocket edition of his very complete catalogue of hoisting engines, steam boilers, etc. The book is copiously illustrated and contains over 70 pages. It is just the right size to carry in one's pocket without being in the least bulky or in the way. Copies, will be forwarded to engineers, contractors and others interested upon application, mentioning this paper.

The Pennsylvania Iron Works Company has recently determined to extend its business by going into the field of hydraulic engineering, and to that end has secured the services of Mr. Ernest W. Naylor, and purchased the rights and privileges of all patents, patterns, etc., owned by him. The company is in a position to enter this new field upon a good basis and any inquiries addressed to it will receive prompt consideration.

The Diamond Machine Company, of Providence, R. I., have just perfected a new and improved machine for grinding cotton mill spindles from the forging. The machine is a combination of their Universal and knife grinders with the necessary attachments for grinding the spindles to the proper taper. The machine gives perfect satisfaction, and although but recently completed orders have been placed by several manufacturers of spindles.

Watson & Stillman have received an order for the building of 15 draw benches for bicycle tube manufacture, each of them with a stroke of 18 feet.

This firm has also for some little time been at work upon a lot of hydraulic machinery for the new American Pulley Works, of Philadelphia, which is to manufacture a new all sheet steel pulley, in which the hub, spokes and rims are all made of thin sheet steel.

Mr. John T. Wilson, late of Wilson, Walker & Company, of Pittsburg, Pa., and Mr. J. D. McIlvain, the well-known car builder, now of Pittsburgh, Pa., have interested themselves in the Powell Improved Furnace, with headquarters at 1204-5 Carnegie Building, Pittsburg, Pa., where they will be glad to meet all their old friends and acquaintances, and new ones, too. The Powell Furnace is adapted to metal working in all the various branches of smelting, puddling or heating.

The American Stoker Company, Dayton, O., have just secured a contract amounting to $24,000, to supply their stoker system to the two power plants of the Baltimore and Catonsville Construction Company, who will operate an electric railroad between Baltimore and Washington. The power plants are located one at Washington and the other at Baltimore, and are each of 300 horse power, requiring something like 40 of the American Stoker Company's apparatus to operate.—*Iron Age.*

The manufacturers of the Leach sanding apparatus for locomotives announce that they now have a working model, similar to those heretofore furnished air-brake instruction cars for educational purposes, which has been designed expressly to meet the demand from engineers' and firemen's clubs and lodges. These will not be given away, but will be sold at a nominal price, found necessary for their own protection. Full particulars can be obtained from Henry L. Leach, North Cambridge, Mass.

The Norfolk Creosoting Company, of Norfolk, Va., has completed a fully equipped plant, including three 100-feet cylinders, and all the labor-saving appliances for treating timber of all kinds by oil of coal tar process, with either live or superheated steam. Mr. Edmund Christian, General Manager and Engineer, gives his entire attention to the details of the work. He has had 15 years' experience in treating all kinds of timber and much of the pile work in Norfolk harbor and adjacent waters has been treated under his exclusive supervision.

Robert W. Hunt & Company, 1137 The Rookery, Chicago are inspecting the construction of 150 cars at the works of the Ensign Manufacturing Company, Huntington, W. Va., for the San Francisco & San Joaquin Valley Railway. The same firm will inspect the 600 ore cars to be built by the Pullman Company for the Duluth, Missabe & Northern Railway; 450 ore cars to be built by the Terre Haute Car and Manufacturing Company for the Duluth & Iron Range Railroad, and 400 ore, 20 flat and 4 caboose cars to be built by the Wells & French company for the Lake Superior & Ishpeming Railway Company.

A suit has been entered by the Harris Car Company, of which Mr. Leslie J. Harris is President, against the American Palace Car Company and George A. Denham, Treasurer, in the United States Court of the District of Massachusetts, which involves a patent, covering the exclusive use in sleeping cars of a berth pocket beneath the floor. The Harris patent, on which the suit is based, is well known to railroad men, as a car, "Jeannette," was built in accordance with the same, and was exhibited in all parts of the United States, Canada and Mexico. It is alleged in the bill of complaint that the American Palace Car Company has constructed a car, "Boston," which is a direct infringement of the claims in the Harris patent.

The H. W. Johns Manufacturing Company, which received a gold medal—the highest award of merit—for its exhibit of asbestos manufactures at the Atlanta Exposition, has issued a neat little pamphlet containing illustrations of nine locomotives exhibited at the exposition whose boilers were lagged with the company's asbestos cement felting or fire felt lagging. The fire felt is pure asbestos made in sheets 24 by 36 inches and from ¼ to 2 inches thick. The cement felting is composed of asbestos fiber, infusorial earth, and a cementing compound, forming a light porous covering that is applied by mixing with water and putting it on with a trowel, the boiler being warm at the time. Both are excellent boiler laggings.

A great many people, who saw and admired the wonderful electric lighting machines furnished by the Westinghouse Electric and Manufacturing Company to the Columbian Exposition Company for the purpose of illuminating the World's Fair, remarked at the time: "What will be done with these machines when the Fair is over." It may be interesting for these people to learn, that the Westinghouse Company recently furnished four of them to the United Electric Light and Power Company, of New York City, and they are furnishing current for lighting a considerable portion of the metropolis. Several others are installed in the plant of the Brush Electric Light Company at Baltimore, while the rest of them are distributed in several large electric light plants throughout the country.

The Davis & Egan Machine Tool Co., of Cincinnati, formerly the Lodge & Davis Machine Tool Co., controls unlimited capital and the plant which now has 60,000 square feet of floor space will be largely increased. New lines of heavy railroad tools will be added and the business promises to be one of the most extensive of the kind.

The concern manufactures tools for the production of locomotive and stationary engines, steam pumps, electric dynamos and motors, agricultural implements, sewing machines, bicycle machinery, wood-working machinery, mining machinery, etc. It has furnished the United States Government large numbers of machines for the manufacture of cannons, guns, etc., and is well represented in the Navy Yards at Washington, Norfolk, Watervliet, Brooklyn and Mare Island. It cultivates the export trade largely and has made shipments to nearly every civilized country. It has agents who travel in Mexico, South America, Russia, France and Germany. The company operates its own stores in New York, Chicago, Philadelphia, Boston and St. Louis.

The Manufacturers' Advertising Bureau, Benj. R. Western, proprietor, which has been located for a number of years at 111 Liberty street, New York City, will remove about April 15 to more commodious quarters at 126 Liberty street. This concern is widely and favorably known throughout both this country and abroad, and is unique in the business it transacts, which is unlike any other in the world, and consists in taking entire charge of the newspaper work and advertising for manufacturers who desire this very important department of their business conducted with the greatest convenience and profit. The bureau handles almost exclusively concerns who advertise in the trade journals, Mr. Western being a recognized expert in advertising media of this character, and has established a reputation for commercial integrity and scrupulous attention to the interests of its clients, of which it may well feel proud. A large number of the leading machinery concerns in the country now entrust their advertising to the care of this institution. It is because of a growing need for better facilities to transact its business that the change from 111 to 126 will be made.

It is announced that negotiations between the General Electric Company and the Westinghouse Electric & Manufacturing Company resulted last month in an arrangement with respect to a joint use of the patents of the two companies, subject to existing licenses, on terms which are considered mutually advantageous. It has been agreed that after certain exclusions the General Electric Company has contributed 62½ per cent. and the Westinghouse Electric & Manufacturing Company 37½ per cent. in value of the combined patents, and each company is licensed to use the patents of the other company except as to the matters excluded, each paying a royalty for any use of the combined patents in excess of the value of its contribution to the patents. The patents are to be managed by a board of control consisting of five members, two appointed by each company and the fifth selected by the four so appointed. Both companies have acquired during their existence a large number of valuable patents, and numerous suits have been instituted in consequence of the infringement of these patents by one party or the other or by their customers. In the prosecution of these suits large sums of money have been expended, and the general expenses of the companies have in this manner been greatly increased. It is expected that the economies to be effected will be very considerable and that the two companies and their customers will be mutually protected. The especial incentives which led to the arrangement at this time, were the recent decisions in favor of patents of the General Electric Company controlling the overhead system of electric railways, the approaching trials of a number of other important General Electric patents on controllers and details of electric railway apparatus and systems of other electrical devices, and the equally strong position of the Westinghouse Company in regard to power transmission, covered by patents of Nikola Tesla, and in view of its other patents in active litigation, some of which are of controlling importance.

New York to California.

A new line of Pullman's latest Compartment Sleeping Cars was inaugurated in January, on the Southern Railway's Piedmont Air Line Limited between New York and New Orleans, connecting with similars cars on the Southern Pacific "Sunset Limited." These cars leave New York on every Tuesday and Saturday at 4.30 p. m., connecting at New Orleans with the Pacific Coast Flyer. These cars are most elegantly furnished and have two drawing-rooms and seven state-rooms. These rooms can be used separate or thrown into a suite or private apartment. The state-rooms are unsurpassable in completeness, having private folding washstand, and all conveniences of most modern drawing-room cars.

Our Directory

OF OFFICIAL CHANGES IN MARCH.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atchison, Topeka & Santa Fe.—Mr. John Purcell has been appointed Assistant Master Mechanic at Argentine, Kan.

Baltimore & Ohio.—Mr. John K. Cowen, President, and Mr. Oscar G. Murray, First Vice-President, have been appointed Receivers. Robt. B. Campbell, General Manager, has resigned and is succeeded by Mr. Wm. M. Greene. Mr. Harvey Middleton has been appointed General Superintendent of Motive Power, vice Mr. G. B. Hazlehurst, resigned.

Chicago, Burlington & Quincy.—Mr. F. A. Chase is appointed Master Mechanic of the Missouri lines, with headquarters in St. Joseph. Mr. I. N. Wilbur is made Division Master Mechanic at Hannibal to succeed Mr. N. J. Paradise, deceased.

Choctaw, Oklahoma & Gulf.—Mr. Henry Wood, formerly Acting Manager, has been made General Manager, with headquarters at South McAlester, I. T.

Cincinnati, Hamilton & Dayton.—Mr. Chas. G. Waldo, formerly General Superintendent, has been appointed General Manager, vice Mr. Wm. M. Greene, resigned.

Columbus, Hocking Valley & Toledo.—Mr. W. A. Mills, heretofore Assistant to the President, has been appointed General Manager, with headquarters at Toledo, O.

Cooperstown & Charlotte.—The office of General Manager has been abolished.

Great Northern.—Mr. T. E. Adams, Master Mechanic of the Northern Division, has been appointed Superintendent of the Dakota Division, vice Mr. Russell Harding. Mr. T. E. Cramer has been appointed Master Mechanic of the Northern Division, to succeed Mr. Adams.

Indiana, Illinois & Iowa.—Peter Maher has been appointed Master Mechanic, vice L. H. Miller, resigned.

Interoceanic of Mexico.—Mr. Theodore Klein will, on May 1, take the position of General Manager.

Kansas City, Pittsburgh & Gulf.—Mr. E. Dawson has been appointed General Master Mechanic, with headquarters at Pittsburgh, Kan.

Lake Shore & Michigan Southern.—Mr. W. H. Canniff, formerly General Superintendent has been appointed General Manager, Mr. P. S. Blodgett, formerly Assistant General Superintendent has been appointed General Superintendent.

Michoacan & Pacific.—The office of the General Superintendent, Mr. L. B. Gordan, removed from Maravatio to Las Trojes.

Monongahela River.—Mr. H. G. Bowles, heretofore General Manager, has been appointed General Superintendent, and Mr. J. A. Fickinger is appointed General Manager. Headquarters, Monongahela, W. Va.

Monterey, Mineral & Terminal.—Mr. M. C. Grace has resigned as Master Mechanic.

Pittsburg & Western.—Mr. Thos. M. King, Second Vice-President of the Baltimore & Ohio, has been appointed receiver by Judge Bullington, of the United States Circuit Court.

Rock Island & Peoria.—Mr. H. S. Cable has been appointed Vice President and General Manager.

Southern.—Mr. E. L. Chapman has been appointed Assistant Superintendent of Motive Power.

Terminal Road of St. Louis.—Mr. William Taussig has resigned the Presidency and is succeeded by Mr. Julius S. Walsh. Mr. E. P. Bryan, General Manager, is made Vice-President in place of Mr. Walsh.

Texas Central.—Mr. Henry McHarg has been elected President.

West Shore.—Joseph B. Stewart has been appointed Superintendent of the Hudson River Division, Superintendent of the Walkill Valley road, and Superintendent of the Jersey Junction road, in place of William G. Wattson, deceased.

AMERICAN ENGINEER
CAR BUILDER AND RAILROAD JOURNAL.

MAY, 1896.

CONTENTS.

The Wheeling & Lake Erie is in the market for from 200 to 500 box cars.

The Chicago & Great Western is said to be in the market for 200 furniture cars.

The Chicago Great Western road will soon give orders for several hundred freight cars.

The Baldwin Locomotive Works have an order for 60 additional locomotives for Russia.

The Lehigh Valley has let a contract to the Michigan-Peninsular Car Company for 1,000 box cars.

The Seaboard Air Line is said to have ordered 12 locomotives from the Pittsburgh Locomotive Works.

The Wells & French Car company has received an order from the Pennsylvania Railroad for 100 hopper-bottom cars.

The New Orleans & Northeastern has given an order for two locomotives to the Richmond Locomotive & Machine Works.

Haskell & Barker, of Michigan City, Ind., are reported to have an order for 150 furniture cars from the Chicago & Northwestern.

The Wisconsin & Michigan Railroad has awarded a contract for 250 box cars to the Missouri Car & Foundry Company, St. Louis.

The Richmond Locomotive and Machine Works has secured an order from Albert Waycott & Co., of St. Louis, for two 55-ton engines.

The Michigan Central road, it is reported, will soon place an order for a large number of freight cars. It is also said to be in the market for about 40 locomotives.

The Delaware, Lackawanna & Western, which recently placed an order with Jackson & Woodin for 1,000 cars, will soon be in the market for an additional 1,000 cars.

The receivers of the Philadelphia & Reading have applied to the United States Court for authority to order 1,000 additional coal cars, 25 refrigerator cars, 250 gondolas and 250 box cars.

The Philadelphia & Reading has placed a contract for 16 coaches with the Pullman Car Company. These cars will be used between Philadelphia and Atlantic City, and will be equipped with Pintch gas and steam heat.

The Grand Rapids & Indiana has placed orders with the Pullman Palace Car Company for three coaches and three combination passenger and baggage cars. The specifications call for the coaches to be 60 ft. long and to seat 70 people.

essrs. Cramp, the well-known shipbuilders, of Philadelphia, have purchased the patent rights of the Yarrow water-tube boiler, and are urging the United States Government to adopt this steam generator in some of the vessels now under construction.

A premium of £50 is being offered by the Verein Deutscher Ingenieure for the best critical paper, in German, on the development of steam engine construction in all industrial countries during the past 50 years. All papers are to be sent in by Dec. 31, 1898.

Messrs. James Howden & Company, of Glasgow, have in the year just closed entered into contracts for the application of their forced-draught system at home and abroad to no fewer than 105 large steamships having an aggregate of 278,500 I. H. P., among which are vessels equal in size and power to the largest steamships afloat.

The statement has been made that the Pullman Palace Car Company is operating one of the departments of its works at Pullman by means of compressed air. This is not the case, but the company has in contemplation the use of compressed air to a limited extent and by way of experiment. The whole matter is as yet undecided.

President Caldwell, of the Lake Shore, is credited with saying that thus far his road has been a gainer by the construction of suburban electric roads. While these roads may have cut into the local passenger business they have on the other hand proved good feeders, and have brought long-distance passenger traffic to the road from points not on its line

During the last fiscal year of the government there were exported from the United States a total of 1,934 passenger and freight cars for steam roads, and their value is placed at $868,378. Of these 103 went over the Canadian border, 267 to Mexico, 123 to Central America, 4 to the West Indies, 316 to Brazil, 113 to Argentina, and 27 to Venezuela, besides several small orders to other South American countries and a very few to Europe.

It is expected that the contracts for the 5,000 cars to be built for the Baltimore & Ohio Railroad will be given out before the first of the month, but at our time of going to press the result has not been announced. The company invited bids on 5,000 cars, 1,800 of which are box, 1,800 solid bottom coal, 400 drop bottom coal and 1,000 drop bottom coal with coke racks. It is rumored that instead of 75 new locomotives the company will purchase 100.

The process of cold riveting has been largely adopted in Europe in the construction of vessels of light scantlings, such as torpedo boats and torpedo-boat destroyers. In this connection an interesting series of experiments has been recently carried out to determine the pressure necessary for successfully closing up cold rivets. The results are said to have conclusively demonstrated that a pressure of at least 30,000 pounds per square inch of rivet section was required. We would have thought that even higher pressures would be required.

A double-track extension about three-fifths of a mile long is being built by the Liverpool Overhead Electric Railway. For 850 feet the tracks are on a viaduct and then they enter a tunnel 2,400 feet long. The chief feature of interest about the tunnel is that it crosses the tunnel of the Cheshire Lines Railway, there being only three feet between the two. To prevent an additional weight being put on the lower tunnel, a relieving arch is being built immediately over it, upon which will be constructed the side walls of the upper tunnel

It is stated that the Northern Pacific Railroad contemplates doing more sluicing along the main line in the Cascade Mountains this season than ever before. Twice as many men will be worked and seven bridges located between Easton and Weston will be filled beneath. These bridges run from 50 to 80 feet in height, and are 400 to 500 feet in length. Work will begin in the middle of April and continue as long as water for sluicing is obtainable in the mountains. Gradually all the trestles and small bridges along the entire line are being filled under solid.

Work has been begun upon the electric road between Baltimore and Washington. The grading of the roadbed at both ends of the line is now being carried out. It is proposed to run the cars on this line at a speed of 60 miles an hour, and the tracks are to be built of the heaviest steel rails. The power plant for the road has been contracted for with the Westinghouse Electric Company, there being two power stations, one located about 10 miles from the Baltimore terminal and the other 10 miles from the Washington terminal. The initial power equipment contracted for is equal to about 6,000 horse power.—*Iron Age*.

According to *The Engineer* Messrs. Thornycroft & Company have succeeded in producing a vessel which is not only the fastest vessel in the world, but has attained that position almost at her first effort. It is well known that as a rule fast vessels are worked up by degrees to their maximum speed, small alterations being usually required in the fitting of the valves, amount of grate, trim of boat, area of propeller, etc. But the *Desperate*, torpedo boat destroyer, designed and built by Messrs. J. Thornycroft & Company, ran a preliminary trial, and obtained a mean speed, on four runs on the measured mile, of 31.035 knots, or 35¾ statute miles. The speed was taken by Admiralty officials, and is the highest on record.

The Technical Club, recently organized by the members of the engineering professions in Chicago, will establish its headquarters at 228-230 South Clark street. This location is directly opposite the post-office, and near the large office buildings in which so many engineers are located, and is convenient in every respect. The club will occupy three floors of the building, and the rooms will be remodelled to suit its requirements. Library, assembly, lounging and billiard rooms will be provided, also public and private dining-rooms, and rooms for the use of technical societies. The quarters will be heated by steam and lighted by electricity. Mr. Robt. W. Hunt is President of the club, Mr. Chas. E. Billin, secretary, and Mr. H. F. J. Porter, Treasurer.

Some months ago, H. M. S. *Penguin*, Commander A. F. Balfour, R. N., found in the Pacific Ocean deeper water than any yet known in latitude 23.40 S., longitude 175.10 W., but had failed to determine the exact depth owing to breakage of the wire at 4,900 fathoms. Captain Balfour has since been enabled to try again, and has announced three satisfactory soundings of over 5,000 fathoms. The deepest trustworthy sounding heretofore known is 4,655 fathoms, near Japan, obtained by the U. S. S. *Tuscarora* in 1874. The deepest of the *Penguin's* casts is 5,155 fathoms, or 500 fathoms (3,000 feet) deeper; but it is especially remarkable that the three casts now obtained are not in the same hollow, but are separated by areas of considerably less water, the two extreme soundings being 450 miles apart.

The locomotive tires in use on the Great Eastern Railway are made of Bessemer steel, having a tensile strength of 40 tons per square inch, and the following composition: Combined carbon 0.350 per cent.; silicon, 0.083 per cent.; sulphur, 0.061 per cent.; phosphorus, 0.047 per cent.; manganese, 0.605 per cent.; iron—by differences—98.851 per cent. The wear on the tires of some six-wheeled coupled suburban engines in severe service was such that only 2,187 miles was obtained per 1/16-inch reduction in thickness, the tires being 4 feet in diameter. Consequently seventeen of these engines were fitted in January, 1892, with special hard steel tires, having a tensile strength of 48 tons to the square inch, and the results obtained up to their first turning were satisfactory. The average mileage was 47,134 for an amount of wear equal to ½-in. in thickness, or 5,893 miles per 1/16-inch reduction.

From a report by the Belgian Vice-Consul at Yokohama, it is learned that railway construction in Japan was interrupted by the war with China, but again great activity is being displayed. A sum of 25,000,000 yen (about $12,500,000) has been voted for the construction of a double line from Tokyo to Kobe. This line is 370 miles long and passes through the commercial and industrial centers of Japan, Yokohama, Kyoto, Osuka and Kobe. A quarter of a century ago there was not a single mile of railway in Japan. Official figures state that in March, 1895, there were in the country twenty-nine railway companies which had obtained concessions, and 1,549 miles had been opened for traffic. The state railways comprised 580 miles of line completed and 398 miles in course of construction, and for which funds had been voted.

Prof. Weighton, of the Durham College of Science (England), who has made some tests to determine the best angles for the heads of countersunk rivets for ships plates, says: Assuming the specimens were all good representatives of a class, I am inclined to draw the following deductions, viz.: First, for ¼ inch plates the countersunk should not be less than 56 degrees, and even a greater angle would seem to be not amiss. Second, for ½-inch plates the countersink should not be less than 35 degrees. For other thicknesses the angle of countersink would be in proportion, and therefore, third, the following would be about the angles proper for the different thicknesses:

¼-inch	plate,	56	degrees	angle of	countersink.
⅜	"	45	"	"	"
½	"	35	"	"	"
⅝	"	26	"	"	"

Mr. F. W. Webb, Locomotive Superintendent of the London & North Western Railway, has followed closely the development of electric traction for railway work in America, and he has evidently great faith in the feasibility of working main line traffic by this method. Speaking recently at the Crewe Mechanics' Institute he declared that the time might come when trains would run daily from London to Carlisle—300 miles—without stopping. In fact, he said he was prepared to run trains from Euston to Aberdeen without a stop, and guarantee punctuality on arrival. He was prepared also to run trains by electricity, and he predicted that within a few years electric trains would be run to all the great centers at a speed that it was now difficult to realize. Those who have visited the Crewe works will recall the extensive use that has been made of electricity in manufacturing operations, and will be quite prepared to believe that Mr. Webb has good grounds for these somewhat startling declarations.—*Railway World*.

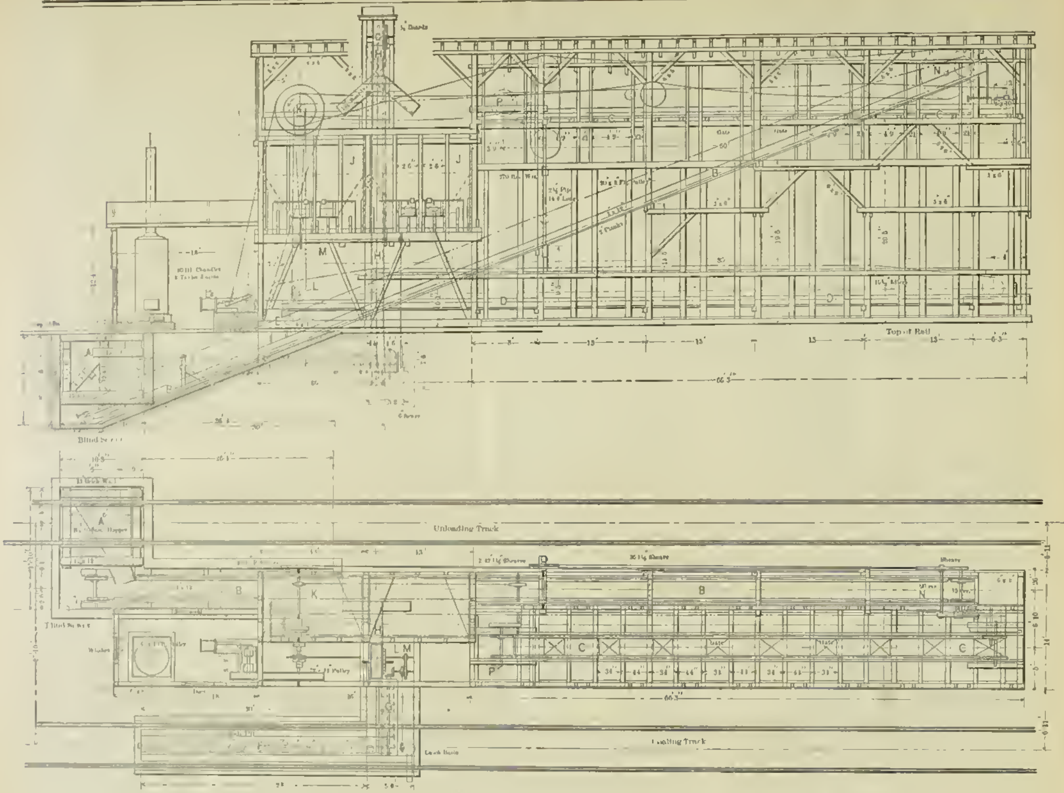
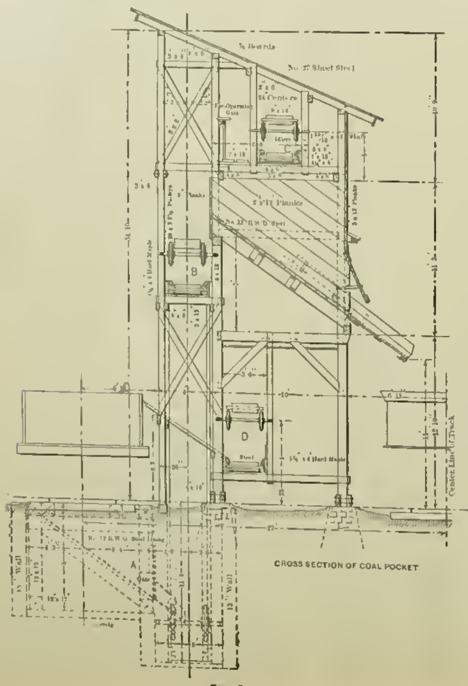


Fig. 5. Elevation and Plan.



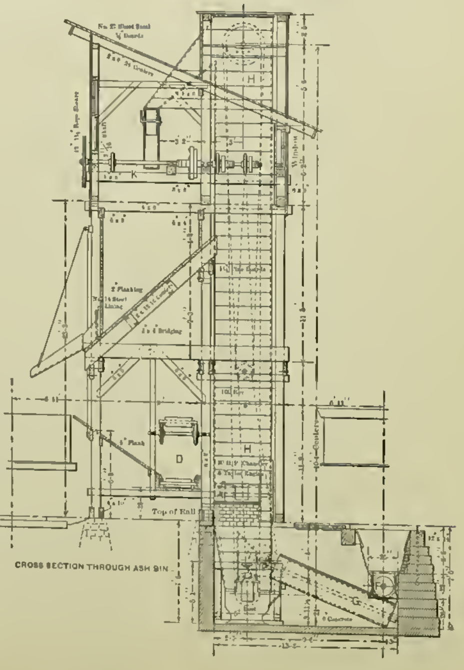


Fig. 6. Fig. 7

WABASH COALING STATION.—CLEVELAND, CINCINNATI CHICAGO AND ST LOUIS RAILWAY.

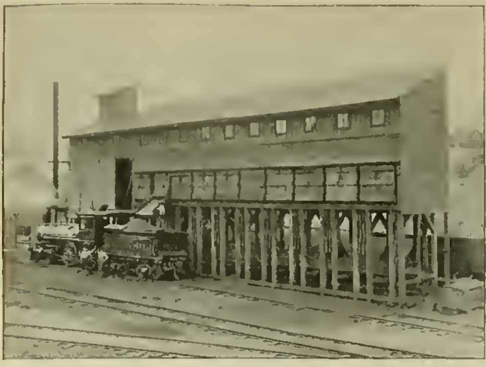


Fig. 1. Front View of Coaling Station.

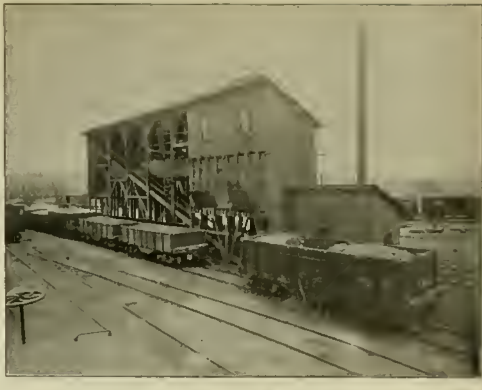


Fig. 2. Rear View of Coaling Station.

Fig. 3. Pocket Conveyor.

Fig. 4. Shoveling Conveyor.

VIEWS OF COALING STATION AT WABASH, IND.—CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS RY.

Coaling Station at Wabash.—Cleveland, Cincinnati, Chicago & St. Louis Railway.

At the new shops of the Cleveland, Cincinnati, Chicago & St. Louis Railway at Wabash, Ind., the company has installed an interesting locomotive coaling station. It is one of the very few plants constructed in this country for locomotives in which the coal and ashes are both handled by conveyors. Through the kindness of Mr. Wm. Garstang, Superintendent of Motive Power, we have had the privilege of inspecting the plant, and from him we had received the drawings and photographs from which the accompanying illustrations were made.

The chute contains ten coal and two ash pockets, and stands between two tracks, one of which is for the locomotives when being coaled, and the other for cars bringing coal to the chute or carrying away ashes. Of our four half-tone illustrations, Fig. 1 is a view of the side toward the coaling track, showing a locomotive taking coal, while behind the structure are a number of coal cars on the unloading track; though it does not show very clearly, there is an ash pit under the engine, and extending for some distance in front of it; Fig. 2 is a view from the other side, showing the two ash pockets and some of the conveying machinery; Figs. 3 and 4 are interior views showing the pocket and shoveling conveyors respectively. Figs. 5, 6 and 7 are from the working drawings, and show the arrangement of the machinery.

The building is 92 feet 3 inches long and 14 feet wide, with a low extension 18 feet long at one end, in which is placed the engine and boiler. Coal is received in hopper or flat bottom cars on the unloading track. If the cars have hoppers they unload directly into the steel hopper *A* located in the pit between the rails and clearly seen in both views of Fig. 5 and also in Fig. 6. From thence it is delivered through a gate onto the inclined conveyor *B B* which carries it to the top of the building and to the right hand end of it as seen in Fig. 5. There it is dumped onto an inclined chute which delivers the coal to the horizontal conveyor C, which passes over the pockets. Over every pocket there is a gate in the trough of the conveyer as seen in the plan view of Fig. 5. Each gate is opened and closed by a rack and pinion operated by the hand wheels seen in Figs. 3 and 7. When a gate is closed the coal is conveyed over it and beyond to the first open gate, through which it drops into the pocket. Battens on the sides of each pocket indicate the height to which they must be filled for two tons, three tons, etc. From the pockets the coal is, of course, delivered to the locomotive in the usual manner.

Should the coal arrive in flat bottom cars it is then necessary to shovel the coal out of them. Provision has been made for this by providing another horizontal conveyor *D D*, shown in section in Fig. 7. It is also to be seen in Fig. 4, and a glimpse of it is obtained between the posts in Fig. 1. Onto this conveyor the coal falls after it is shoveled out of the car on to the inclined planking shown (Fig. 7). It is by this conveyor taken to the left, in Fig. 4, and delivered through the short chute *E* on to the inclined conveyor *B B*, whence its travels are the same as in the previous case. Of course the coal is transported to the chute in hopper cars where possible, as then there is no shoveling whatever, and no hand labor of any kind.

The manner of handling the ash is equally interesting. An ash pit 28 feet long is located between the rails in front of the engine and boiler house. The bottom of the pit consists of cast-iron gratings made in short sections. Under these there is a screw conveyor running the whole length of the pit and delivering the ash to another screw conveyor placed at right angles to it. This in turn carries the ash into the boot of the elevator *H H*, which takes it to the top of the building and, by means of two aprons, delivers it into the two ash pockets. When the locomotive ashpans are emptied into the pit the plates forming the bottom of the latter are in place, of course, and when the ash accumulates, the conveyor is started up, the plates removed one by one, so as to feed the ash into the conveyor with regularity, and the process goes on, as already described, until the pit is empty. The plates are then put back and the pit is again ready for use.

When the two ash bins are full, a car is run in on the coal unloading track and the ash delivered to it in exactly the same way as an engine takes coal. It will be noticed that the pockets have iron aprons, but the latter are not balanced. Thus the ash is shipped away without any manual labor whatever.

We have described the manner in which the materials are handled, and would now direct attention to the driving mechanism. The small boiler house at the end of the structure contains a 30 horse-power engine and boiler. The boiler is not used at present, however, as steam is taken from the shop boiler. By means of a belt the engine drives the shaft *K*, almost directly above it. From this shaft there is a cable drive to the shaft *N* at the other end of the building, for operating the inclined conveyor. A chain belt to the shaft *P* drives the horizontal conveyor *C C* over the pockets, and another chain belt from the same shaft *K*, to the shaft *L* drives the shoveling conveyor; still another, with a quarter-turn in it, leading to the shaft *M* drives the ash elevator and screw conveyor. Similar reference letters in the different figures refer to the same objects, and our readers will find no difficulty in tracing out the various driving mechanisms.

The plant was built for the company by the Link Belt Machinery Company, of Chicago, and the details of the conveyors and other apparatus all conform to their well-known and successful designs. The plant has been in operation for some months, and has given perfect satisfaction. Mr. Garstang informs us that as far as its machinery is concerned, the plant could coal nearly 100 engines a day. The coal conveyors will place a carload of coal into the pockets in a very few minutes, and the ash is also handled with dispatch. By means of suitable clutches, the ash and coal conveyor can be operated together or either one alone, the engine having power enough to keep everything moving at once. Three men are required about the plant when it is in full operation, but it does its work so rapidly that these men do not give their entire time to it, but are assigned other duties. The cost of the plant was hardly any more than would have had to be expended for an ordinary coaling station with a trestle, an ash pit, depressed tracks, etc. This station also occupies less space than any stations of the same capacity having one track on a trestle and another depressed, and this is an important consideration in many cases.

The plant is an excellent illustration of what can be done in reducing the cost of handling coal and ash with a comparatively small outlay, and its compactness and large capacity, the reduction of labor and the general excellence of the design, should induce railroads to look upon such machinery with greater favor. It is pretty safe to say that the item of labor in coaling locomotives and disposing of their ash is much greater than is generally believed, and that the subject does not receive the attention it deserves. At large terminals, or points where many engines are coaled daily, conveyors have been introduced, but we think that few, if any, conveyors have been installed at coaling stations of moderate size, excepting the Wabash plant. But the small stations are the more numerous and should receive attention. A large economy over present practice can be effected, and the plant we have described is an excellent example of how it can be done.

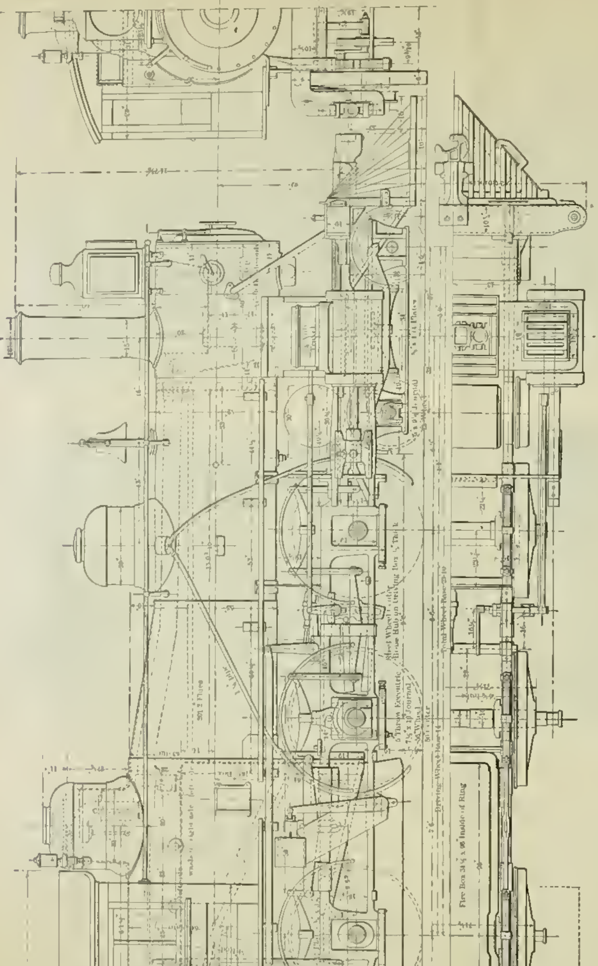


Fig. 1. Ten-Wheeled Freight Locomotive.—New York, Chicago & St. Louis Ry.

Ten-Wheeled Locomotive—New York, Chicago & St. Louis Railway.

The New York, Chicago & St. Louis Railway has recently put in service ten new 10-wheeled freight engines, five of which were built by Brooks Locomotive Works, and the remaining five by the Schenectady Works. Through the courtesy of Mr. John McKenzie, Superintendent of Motive Power, we publish the accompanying illustrations of them.

The engine has 18 by 24 cylinders, which in some sections of the country would not be considered large, but as the divisions of the road on which these engines operate have no grades heavier than 40 feet to the mile, and only a few as steep as that, this size of cylinder is found large enough to haul a train of 43 cars in all ordinary weather and one of the engines is stated to have handled a train of over 1,200 tons on this grade.

The engines have rigid center trucks, and the plain tires are placed on the forward pair of drivers. The links are back of the forward axle and neither long eccentric rods nor intermediate rockers are employed. A respectable radius of link, 45 inches, is obtained and the whole link motion is as free of objectionable features as in an ordinary eight-wheeled engine.

The boiler, shown in Fig. 2, is of the wagon top style and 52 inches in diameter at the first course. The crown is stayed with crown bars, and the firebox is between the frames and over the rear driving axle. The boiler is of substantial construction throughout, and some of its details are uncommon. The longitudinal seams are butted with inside and outside welts. The circumferential seams are double riveted. In the construction of the firebox, the flange of the tubesheet is made of the usual length at the top and for a short distance down the side, but as the sheet narrows the flange deepens until it measures 9½ inches. This does not cause any waste of metal, and it carries the seam away from the corner of the firebox ring, which is believed to be an advantage. It is expected to prevent cracking of the sheets at the seams. The ring has drop corners and is machined inside and out at the corners. It is "set in" one inch opposite the driving boxes, but its full width of 3 inches is maintained. The water space of 4 inches at front is straight, but the back and side spaces enlarge toward the top, those at the sides becoming 7¼ inches. This is believed to be the best possible preventive of broken staybolts. The crownsheet is not arched, but is given a flat slope on each side of the center.

The crown is supported by bars 5 inches by ⅝ inch, and from each of these there are two sling stays to the shell. Their upper ends are attached to long tee irons made out of two sheets bent into the form of angles, and extending from near the back head to the dome, with a short section ahead of the dome also. All stays, whether they go to the shell or the dome, have a pin joint in them just above the crown bar. The back head and front tubesheet are supported by gusset stays. The wide water spaces at the sides of the firebox have necessitated two additional stays on each side below the crown, as shown.

The thimbles for the crown-bar bolts are of cast steel, and are not of the conical form so usual in American practice. From the detail shown in Fig. 3 it will be seen that they are cylindrical, one-fourth of an inch thick, and have a rectangular flange at the top end, on which the crown bars have contact. A small projection fits between the bars and prevents the thimble from turning.

The dome is secured to the shell by a solid ring ¾ inch thick and flanged upward for the dome sheet. It measures 6¾ inches by 4¼ inches by ¾ inches in section. The firebrick in the firebox is supported upon 2¼-inch water tubes. The heating surface of the arch tubes is 10 square feet, the

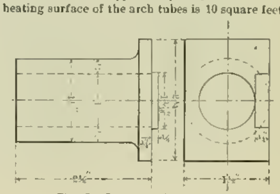


Fig. 3.—Crown Bolt Thimble.

firebox is 145 square feet, and tubes 1,360 square feet, giving a total of 1,515 square feet, while the grate area is 22.4 square feet.

In looking over the elevations in Fig. 1 the reader will notice that most of the details conform to common practice. One departure might be mentioned. The pedestals in the main frames for the rear and front drivers are perfectly straight and two shoes are used instead of the one shoe and one wedge per pedestal, which has been the almost universal practice for years. This arrangement by which a ready adjustment for wear at the driving boxes is deliberately dispensed with, is meeting with favor among those whose observation has led them to conclude that more trouble is caused by unwise adjustment than can arise from the lack of any take-up. The main pedestal has the old form of shoe and wedge, evidently provided for fear of pounding at the main journals.

It is customary to close the bottom of the pedestal with a thimble and bolt or a cap, but in these engines their place is taken by a stirrup or strap, which passes outside and around the lower ends of the jaws and is tightened by a large screw bearing on a gib notched into the outside of the jaw to keep it in place. A similar gib at the other end notched into the frame in the same way gives an additional safeguard against the strap slipping out of place. This arrangement is very neat, and has the advantage over the thimble and bolt of not cutting into the frame, while at the same time there is no limit to the strength of the strap; it should be cheaper than a well-fitted cap, and it appears to be easier to remove and put on than either cap or thimble and bolt.

The crosshead is of cast steel and symmetrical with relation to the piston rod. It is a form that many are adopting in place of the Laird type, which by its unsymmetrical form is believed to be the cause of many broken piston rods.

The link motion shown in Figs. 4 and 5 is worthy of attention. All bearings are very large. The link itself is 3 inches wide, and the block is 7 inches long. These substantial proportions are carried into all the details. But perhaps the most interesting feature is the means provided for oiling the various surfaces. Ordinarily most of the surfaces of the link motion are only supplied with oil through a small oil hole each time the engineer goes around with his long snouted oil can, but these engines are expected to haul trains long distances without making stops long enough to permit oiling, and the link motion has been provided with little oil reservoirs in connection with every surface requiring oil. These reservoirs

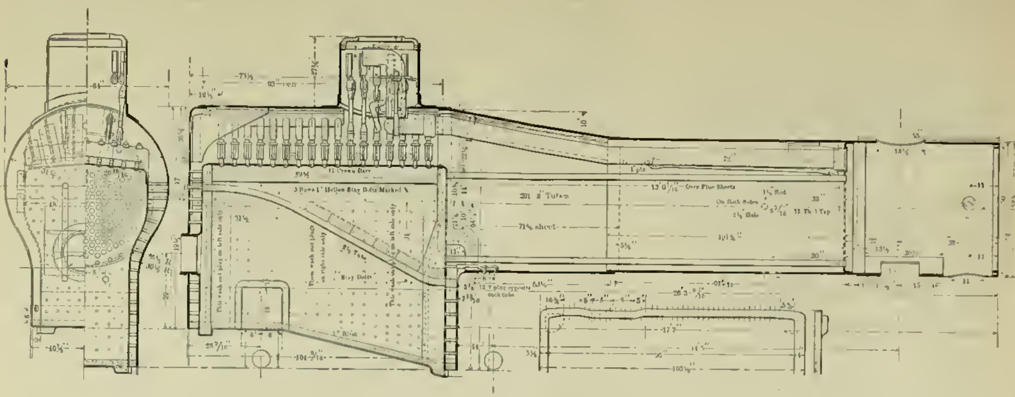


Fig. 2.—Boiler for Ten-Wheeled Freight Locomotive.—N. Y. C. & St. Louis Railway.

are all formed in the solid metal, and therefore are not like an oil cup—liable to be lost. Over each of the eccentric rod pin holes, for instance, there is drilled transversely a hole 1⅛ inches in diameter and 2⅝ inches deep. It is then tapped with a ⅞-16 thread to the depth of ½ inch, and the hole closed by screwing a brass plug in flush. A ¼-inch oil hole from the outside intersects this hole and passes on through the bushing that forms a bearing for the pin. By filling the reservoir thus formed with waste, or a similar retaining material, a sufficient quantity of oil is provided for a long run. In the same way the link hanger pins are supplied with oil. The pin through the link block is lubricated from an open reservoir 1 inch by two inches by one and three-quarter inches in the top of the block. The whole arrangement it ingenious and should lead to a better lubrication with less waste of oil. It should also be noticed that the bushings in the link motion work are not of wrought iron, casehardened, but are of cast iron. Mr. McKenzie has used this material for several years with excellent results.

The eccentric straps on these engines have babbitt-filled grooves extending diagonally across the wearing surfaces. The eccentrics have a 4-inch face, giving ample wearing surface.

These engines have now been in service for some two months and have been a source of satisfaction to the management. Below we give a few of the principal dimensions:

Cylinders	18 inches by 24 inches
Steam ports	16 " 1⅜ "
Exhaust ports	16 " 3 "
Valve travel	5¾ "
Driving wheels	56 "
Driving wheel base	14 feet 0 "
Total wheel base of engine	23 " 10 "
Boiler style	Wagon top
Boiler, diameter of at first course	62 inches
Number of tubes	201
Size of tubes	2 inches O. D. by 13 feet
Firebox	34 inches by 95 inches
Grate area	22.4 square feet
Heating surface of tubes	1,360 " "
Heating surface of firebox	145 " "
Heating surface of arch tubes	10 " "
Heating surface, total	1,515 " "
Steam pressure	160 pounds
Weight on drivers in working order	87,000 "
Total weight of engine in working order	110,000 "

The driving wheels' centers are of cast steel, the axles and rods of hammered iron, and the crank pins of steel treated by the Coffin process. The driving boxes have facings of brass to wear against the driving wheel hubs. The shoes have bearing faces 6 inches wide for the driving boxes. The boiler material is carbon steel. A fire-brick arch is used and is supported on two water tubes. The driver brakes are of the equalized type, and the cylinder and fulcrum for the cylinder lever are attached to the same plate, making a neat arrangement.

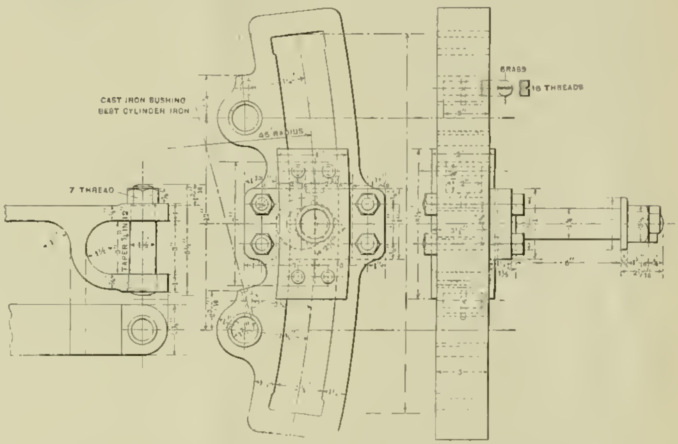


Fig. 4.

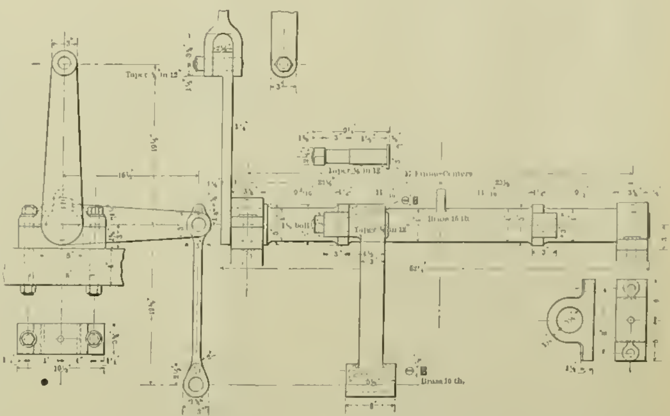


Fig. 5.—Link Motion for Ten-Wheeled Locomotive.

Inadequate Yard Facilities.

In a paper on "Transportation Facilities," recently presented by Mr. D. S. Sutherland, Superintendent of the Michigan Central Railroad, to the Central Association of Railroad Officers, the author pointed out that improvements in yard and terminal facilities had not kept pace with the increase of traffic. He said:

With very few exceptions, railroads are doing their switching the same as it was done when steam railroads first came into existence, and it costs these roads more to get a car through their yard than over any 100 miles of their line. In the first place, a train arriving pulls in and occupies a track in the distributing yard, and if several trains are in company a track is occupied by each, and no switching can be done until the whole fleet has arrived and is gotten out of the way, and the chances are that then this yard is blocked so as to render switching to any advantage almost impossible. A switch engine takes hold of the train and the first move is to pull the train back out of the yard, and for every cut that is made the whole or greater portion of the train must be handled, drawbars are pulled out or broken, and cars receive more damage than they will receive on a trip over the whole line.

Railroad companies realize that in order to meet competition, it is necessary to reduce grades, increase the capacity of engines and cars and in every way possible reduce the cost of transportation, but do not seem to realize that, in order to make this a success, it is necessary to equip their stations and terminals so as to meet the improvements in other quarters. If the capacity of freight engines is increased, it is just as necessary that the capacity of the yard be increased in proportion.

I know of no place where there is such a chance for reduction of cost in handling as at terminals. In order to accomplish this, yards need not necessarily cover any larger territory, but they can be so laid out that the switching can be done promptly and thoroughly, without loss of time and waste of power, and thereby a large reduction in cost and far better results arrived at. What is true of yards is also true of warehouses, meeting and passing tracks and all other transportation facilities.

Plans are being prepared for an addition of two stories to the office portion of the Grand Central Station, New York, and work on it will probably be begun in the spring. The additional office room is needed to bring all the clerical forces under one roof; they are now scattered in several buildings much to the inconvenience of everybody. The work will cost about $250,000.

Experiments on Arches.

An extremely valuable and interesting series of experiments have been carried out by the Austrian Association of Engineers and Architects, on model arches of spans ranging from 4.42 feet up to 75.4 feet. A sum of upward of £4,000 sterling was expended, though the work was to a large extent done gratuitously. The arches of 4.42 feet span were seven in number, and of the following general particulars and dimensions:

	Material.	Thickness at crown.	Rise.	Weight of arch per square foot covered.	Deflection of crown under a load of 1,638 pounds per square foot
		In.	In.	lb.	In.
1	Schober special bricks	6.29	1.58	130	.46
2	Hönel " "	3.94	1.97	71.6	.62
3	Schneider " "	3.94	1.58	128	.94
4	Glockselg " "	3.94	1.58	125	1.63
5	Ordinary bricks, radial joints	5.90	5.70	71	.
6	" " longitudinal joints	5.00	1.91	77	
7	Rammed concrete	2.05	4.52	92	.77

The abutments for these arches were I-beams firmly coupled together by round tie-rods and channels. The arches were levelled up with earth packing, and loaded with pig iron distributed over the whole span. Failure in the case of Nos. 3 and 4 took place with a load of about 1,638 pounds per square foot, but the other arches carried this without showing any signs of rupture. The deflection at the crown was measured in each case at frequent intervals, and the results recorded. In the case of Nos. 3, 4, and 6 the deflection increased more rapidly than the load, but with the other arches a fair proportionality between deflection and load was maintained. The brick arches were laid in lime mortar, and not in hydraulic cement. The concrete arch consisted of one part of Portland cement with five parts of sand. Experiments were next made on arches having a span of 8.85 feet. In this case the load was distributed over one-half the span only. The results obtained are shown by the table on the next page.

In no case was the deflection proportional to the load, though in the case of six it was nearly so. In all these cases the abutments consisted of I-beams efficiently tied together. Some experiments were next made on a concrete arch of 13.3 feet span, 10.1 inches rise, and 3.91 inches thick at the crown. This arch sprang from regular skewbacks, and failed when a load of 790 pounds per square foot was distributed over one-half of the span from abutment to crown. The deflection of the crown at rupture was about ⅛ inch, but a point midway between springing and crown had deflected ⅜ inch before failure occurred. A Monier arch of similar dimensions, tested in the same manner, failed under a load of 872 pounds per square foot, but both arches showed cracks at the same load, viz., 614 pounds per square foot. The deflection of the Monier arch at the crown when failure occurred was ⅜ inch, and at a point half-way between abutment and crown $\frac{1}{16}$ inch. A Melan arch was next tried. In this construction steel arch ribs of I-section are imbedded in the concrete, being spaced in the present instance 3 feet 4 inches apart. The I beams in question were 3.15 inches deep, and the concrete filling was of the same thickness, being flush with their upper and lower flanges. The span was 13.1 foot, and the rise 11.4 inches. The arch was loaded on one side only, and failed when 3,370 pounds per square foot was reached, breaking in three pieces under this load. The first cracks were observed under a load of 3,120 pounds per square foot on the loaded side.

The next arches tested were two of 32 feet 9.7 inches span and 3 feet 3⅜ inches rise, one being of Monier cement and the other of rammed concrete. Each was 13 feet 1.5 inches broad, and carried a single line of standard gage railway. The Monier cement arch was a reproduction of one constructed for actual use in 1889. It consisted of a ring of cement 5.9 inches thick at the crown, and 7.87 inches thick at the springings. The cement was, as usual on Monier's system, reinforced with wire netting. The dead load on the arch, including filling over haunches, ballast, and track, amounted to 307 pounds per square foot. As a preliminary, an engine and tender were run over the bridge and the deflections at the crown and at quarter-span noted. The locomotive had six wheels, the loads being distributed as follows: leading axle, 10.3 tons; driving axle, 13 tons; trailing axle, 13 tons. The tender had four wheels, the load on each axle being 9.1 tons. The maximum deflection noted was $\frac{1}{17}$ inch, of which one-half was permanent set. Still heavier locomotives were then run over the structure, the deformations being noted at 10 different points. No further deformation or permanent set was noted under these loads. Steps were then taken to test the arch to destruction, by piling rails over one-half the span. With 90 tons of rails thus distributed, a crack was observed in the neighborhood of the springings, extending through nearly one-third the total thickness of the arch. On increasing the load to 100 tons, further cracks were noted. This load was left on for 3¼ hours, and the deflections recorded. The load was then totally removed, and the permanent set noted, which amounted to ⅜ inch at the crown. The load was then replaced and finally increased up to 180 tons of rails piled on the half span, when complete failure occurred. The vertical deflection at the crown, under a load of 80 tons, was .36 inches, and at the quarter-span .32 inch. At 90 tons the corresponding deflections were .44 inch and .42 inch, the first crack occurring at this load as already noted. At a load of 170 tons the deflection at the crown was 1.28 inches, and at the quarter-span 1.03 inches. The rammed concrete arch was of the same span, width, and rise; it was, however, 16.4 inches thick. It was built of concrete consisting of one part cement, two parts sand, and one part broken stone. The testing was commenced when the concrete was 224 days old. On loading one-half of the span with rails, the first cracks were noted when the load reached 47.8 tons, or 512 pounds per square foot. These cracks were, for the most part, confined to the spandril walls in the immediate neighborhood of the abutments. Under a load of about 90 tons, however, a crack was perceived in the arch ring about 2 feet from the crown on the loaded side. The load was then removed, the deformations noted, and the load replaced and carried up to 195 tons, which was carried for three days without failure taking place. The maximum deflection at the crown was 1.14 inches, and at quarter-span on the loaded side, 1.12 inches. At quarter-span on the unloaded side the deflection was .49 inch. On removing the load the permanent set at these three points was, respectively, .62 inch, .66 inch and .30 inch.

TABLE SHOWING RESULTS OF EXPERIMENTS ON ARCHES.

Number.	Material.	Span.	Thickness at crown.	Rise.	Weight of arch per square foot.	Breaking load, lbs. per square foot on half span.	Vertic'l deflec'n at cr'n under load. At rupture.	Of 400 lb. per sq. ft.
		ft.	in.	in.	lb.	lb.	in.	in.
1	Rammed concrete	8.85	3.35	9.05	288	1,127	91	.31
2	Ring of cement reinforced with wire netting (Monier's system)	....	1.05	16.23	230	1,217	1.01	.34
3	Ring of cement (Monier's system) levelled up over the haunches with concrete	...	2.17	10.23	506	1,320	1.22	.18
4	Arch of ordinary bricks	.	5.51	9.84	248	883	1.87	77
5	" Honel bricks	....	3.94	5.31	166	491	1.53	1.45
6	" corrugated iron	....	..	9.84	14	973	1.06	.45
7	" " " with L-iron riveted along it at the springing	....	....	..	20	1,100	1.14	.47

We now come to a still more important series of experiments, in which five arches, each of 74.5 feet span and a rise of about one-fifth the span, but constructed of different materials, were tested to destruction. The work was done in a quarry at Puckersdorf, where excellent foundations for the abutments, and cheap material for the construction of the arches themselves, where available. Each arch was 6.65 feet wide. A platform supported on six sets of columns, the feet of which rested directly on the extrados of the arch, extended in each case from one abutment to the crown, and the testing was effected by piling rails on this platform. The first experiments were made upon an arch of cut stone, and on one of brick. The stone used was a fairly hard limestone of excellent quality. The voussoirs were 1.97 feet thick at the crown, and 3.6 feet at the springings. The mortar used was mixed in the proportion of 5 hundredweight of Portland cement to 35 feet of clean sand. The brickwork arch had precisely similar dimensions to the foregoing. The bricks used were machine pressed, and were thoroughly wetted before use. The same quality of mortar was employed. After the work was finished the centers were left in place for some weeks. The whole outer surface of the arches was then covered with a thin coat of cement, so as to detect cracks more readily. The centers were then removed, and the work of loading the arches proceeded with. The stone arch gave way when the load piled on the platform reached an amount equivalent to 1.99 tons per foot run, and the brick arch when the load reached 1.81 tons per foot run. Up to the point of rupture the stone arch gave no signs of incipient failure, but in the case of the brick arch cracks declared themselves previously, which were apparently caused by the failure of the mortar, the bricks themselves being intact. After removing the ruins, a third arch of similar span and rise was constructed between the same abutments, the material being rammed concrete. The thickness of the arch ring was, however, uniform, being 2.3 feet. The body of the arch consisted of 1 part Portland cement, 2 parts broken stone, 3 parts gravel and 3 of sand, but for the intrados and extrados a higher quality of concrete was used, that for the former consisting of one part Portland cement, ½ part broken stone, ½ part gravel, and 1 part sand, while the latter consisted of 1 part Portland cement, 1½ parts broken stone, 1½ parts gravel and 2 parts sand. The total quantity of concrete in the ring was about 50 cubic yards. Two months after completion the centers were removed, during which time the arch was protected from the sun and frequently watered. The testing commenced three weeks after the centers had been removed. Failure took place under a load equivalent to 2.24 tons per foot run on the loaded half of the arch. The next arch to be tested was constructed on the Monier system, the span and rise being as before, while the thickness of the ring was 1.97 feet at the springings and 1.15 feet at the crown. The concrete used consisted of 3 parts of river sand to 1 part of slow-setting Portland cement. The centers were removed at the end of two months, and arrangements made for testing. Failure took place under a load equivalent to 3.09 tons per foot run of the loaded half. Great difficulty was found in removing the ruins. The metal reinforcement was found intact, having bent, but not broken, at the points of failure.

The final experiments were made upon a steel arch of the same rise and span as the four preceding ones. This consisted of two steel ribs fixed at 5.9 feet centers and rigidly braced together. Each rib was of girder section 12.6 inches deep. The total weight of the steel work was 15.6 tons. On testing with a load of 82¼ tons distributed over half the arch, no serious deformation was observed. The load was then removed, and on the next day 158 tons of rails were piled up on the loaded side. The deflection was then considerable, but agreed well with the calculated result. This load was left in place throughout one night, after which rails were piled on the side not previously loaded till a total of 175 tons was reached. The deflection was still further increased, but not a single rivet yielded. The load was then removed, and the experiments terminated. From their experiments the committee concluded that in arches of large span the calculations may safely be based upon the theory of the elastic arch. With a view to distributing the load as much as possible in the case of masonry arches, the extrados should be covered with a layer of ballast, which should be at least 3 feet thick in the case of railway bridges. The safe crushing load on such arches may range from one-tenth to one-fourth the ultimate resistance of the material.—*Engineering.*

Construction and Maintenance of Railway Car Equipment.—V.

BY OSCAR ANTZ.

(*Continued from Page 53.*)

DRAFT GEAR—CONTINUED.

In the draft gears which have been described, the strains are transmitted mostly from the drawbar to the draft-timbers, and through these to the sills and bolsters, and the strength of the gear is therefore largely dependent on that of the draft-timbers and their fastenings to the sills. A number of gears have been introduced in which the strains are transmitted to the frame of the car without the intervention of draft-timbers, by attaching the drawbar stops or their substitutes directly to the center sills. In some of the earlier forms of this kind it was found that when any part of the draft-gear failed it usually damaged the sills to such an extent that they had to be renewed, and but few cars are now built new which do not have some form of draft-timber which can be readily renewed without disturbing the frame.

A draft-gear in which the strains are partly transmitted through the drawbar-stops directly to the frame of the car, while at the same time the larger part of the shocks is taken by the draft-timbers, is in extensive use, principally on the cars of a number of prominent roads in the Middle States, and it is shown in several forms in Figs. 24 to 29.

In this draft gear, as in the one described in the last article, thimbles are used as followers, having collars which bear along their circumference on the drawbar stops, the latter being mortised into the draft timbers at the sides and extended upward at the top and bearing on their ends against a solid filling block bolted securely to and between the center sills.

Figs. 24 and 25 show the original form of this gear, in which $N N$ is a tail pin which passes through the cast-steel followers $L L$ and the draft spring $P P$, and is secured by the key $U U$ against the washer $Q Q$. The followers work in circular holes in the drawbar stops or cheek pieces $D D$, which are fastened each by two ¾-inch bolts through the draft timbers and are mortised into these and the iron straps on the bottom. The upper parts of the cheek pieces are carried back at $E E$ and bear against shoulders cut into a piece of timber, $G G$, which completely fills the space between the center sills for about 8 feet back of the end sill, and is securely fastened to the sills by five ¾-inch bolts. The upper lugs of the cheek pieces have slots in them to allow for inserting and removing the key through the tail pin, and the filling block is also cut out over the back cheek piece for the same purpose.

The draft timbers $A A$ are of 4 by 8 inch oak, cut out ½ inch for the cheek pieces and drawbar spring and further cut out 1 inch deep for the projections on the sides of the cheek pieces. They are fastened to the center sills each by six ¾-inch bolts $B B$, having their heads resting in cast iron sockets or box washers let into the floor. Cast iron key blocks $C C$ and wrought iron tie straps $T T$ are provided in the usual manner to further secure the draft timbers. Below the draft timbers are fastened by the bolts $B B$, the straps $F F$, made of ½ by 3½ inch wrought iron about 3 feet long, with gibs at each end which are let into the timbers; the straps are also cut out 1 inch deep for the sides of the cheek pieces.

The wooden body-bolster and the arrangement of carry iron and other attachments on the endsill, which are shown on the drawing, are not an essential part of this particular draft gear, as any other kind of bolster and front attachments can be used. These are merely shown as being the usual form found on cars with this gear.

The disadvantages in the use of a tail pin or spindle in draft gears generally, have led to several modifications of the draft gear just described, whereby a pocket strap or an arrangement involving its principles is substituted for the pin.

Figs. 26, 27 and 28 show the simplest arrangement, the draft-timbers $A A$, and filling blocks $G G$ being arranged substantially as described for the other form of gear, fastened together by bolts B, B, and key-blocks $C C$, the draft timbers having the straps $F F$ on the bottom, and being tied together by tieplates $T T$. The cheek pieces $D D$ are mortised into the draft timbers as before and are also extended upward and bear against shoulders on the filling blocks. These cheek pieces are provided just below the upper lug with a rectangular slot and are cut out at the bottom to allow the pocket strap $O O$ to pass through. Between the back follower thimble L and the rear end of the strap a malleable casting $Q Q$ is inserted, which is provided with a lug passing partly into the follower and with flanges which guide the strap, keeping it central. A piece of boiler tube, $U U$, is inserted in the followers and draftspring and serves to keep these in line. The pocket strap $O O$ is of 1 by 4 inch wrought iron, is gibbed at its front end and is secured to the drawbar by means of two 1¼-inch bolts having double hexagonal nuts on their lower ends. The filling block and floor above these bolts are cut out, to allow for placing and removing them, and this hole is closed by

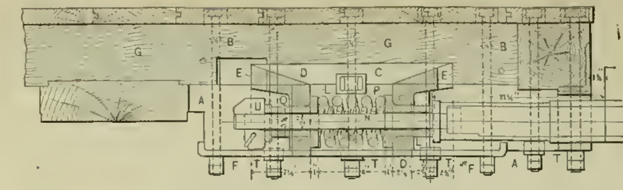


FIG. 24.

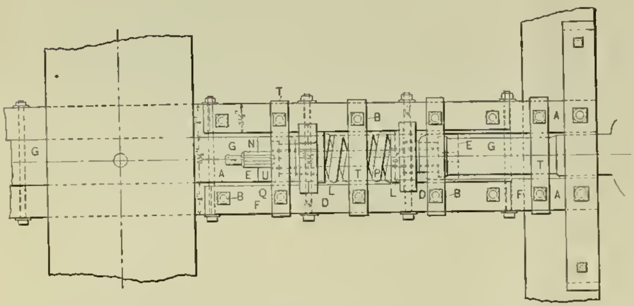


Fig. 25. Inverted Plan.

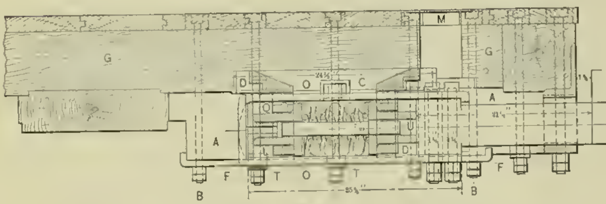


Fig. 26.

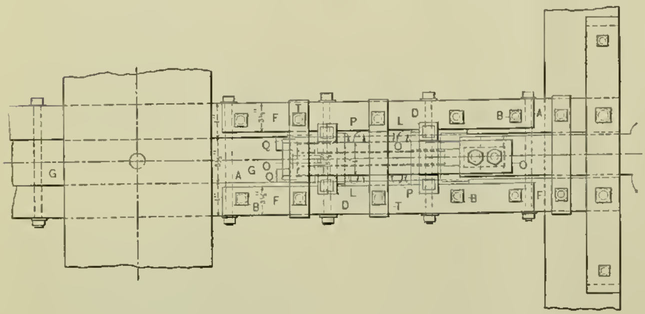


Fig. 27. Inverted Plan.

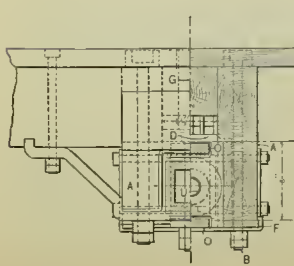
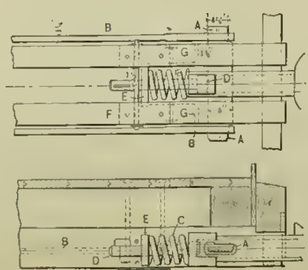


FIG. 28.



FIGS. 29 and 30.

means of a casting, *M M*, let into and secured to the floor by screws.

Another variety of this draft gear, which is used to quite some extent, has two straps of ⅜ by 4-inch wrought iron, riveted on top and bottom of the drawbar by 1¼-inch rivets, and extending back through the cheek pieces and fastened together behind the rear one by means of a 1¼-inch pin; this pin has a lug on one side of its top end, and the holes in the strap through which it passes are made of such shape that this lug will pass through in one position, but will rest on the top strap when given a quarter turn; the pin is locked in place by a key through its lower end, passing between lugs on a distance piece placed between the two straps, which also has a cylindrical lug on its front end which engages the back follower thimble; a piece of pipe or boiler tube is inserted in the two thimbles and the draft spring, and serves to hold these in place.

CONTINUOUS DRAFT GEARS.

In the different draft gears, as far as described, the strains are transmitted from the drawbar to the sills at each end of the car, and from one end to the other by the sills alone. There is a tendency in late years among car-builders to relieve the sills of some of the strains, both pulling and buffing; for the pulling strains this is done by bolting to each draft timber a 1-inch rod with a flat gibbed end, the rod passing back to and through the adjacent crosstie timber, and having a nut on its end resting on a large washer. The crosstie timbers are likewise connected by one or two rods passing between and through them, with nuts on the outside of each, making practically a continuous connection between the draft timbers at the two ends of the car. To take the buffing strains timbers are placed under the center sills, between the rear ends of the draft timbers and the adjacent crosstie timbers, and others between the two crossties, making practically a continuous timber from end to end. These subsills are bolted to the sills and are usually also keyed to them by cast-iron blocks. When wooden bolsters are used the draft timbers usually end at the bolster, and the subsills are fitted between the bolsters and crossties; with iron plate bolsters the draft timbers are sometimes carried back through them for a foot or two, being shouldered against the bolster. In either case, the short draft timbers can be removed if necessary without disturbing the subsills.

Instead of attaching the rods mentioned to the draft timbers, they are sometimes connected directly to the drawbars, forming the so-called continuous draft rigging. There are several kinds of this in use, the earliest introduced consisting of a long rod or spindle which passes through below the center sills and is connected to each drawbar by means of a key. The draft spring is placed directly against the end of the drawbar and at the other end bears against a wooden block fitted between the draft timbers, no follower-plates being used. When a pulling strain is applied to a car with this gear, the spring at the end opposite to the one at which it is applied is compressed, under a buffing strain, the spring at the end where it is applied, comes into action, so that there is always a thrust against one of the spring blocks. The slot in the drawbar or in the spindle must be made long enough to allow the spring to be compressed when subjected to buffing strains, without moving a draft rod. This gear is not much used at present on cars of large capacity, although a modification of it was lately introduced in which the rod was made in two pieces, connected together at the center by means of a right and left turn-buckle, the connection to the drawbar being made by means of heads on the rods instead of the key.

These draft rods pass through the body bolster at the center, and therefore come in the way of the center pin, which has to be cut off and is usually made with a head resting in a socket on the top side of the body center plate, which must be removed to renew the pin. To overcome this objection the draft gear shown in Figs. 29 and 30 has been devised. The rear end of the drawbar is provided with a horizontal slot, through which a key *A A* of 1 by 5 inch wrought iron passes: this key is long enough to also pass through the two draft-timbers and project about 3 inches. Two draft rods *B B* are employed, which are made of 1½ inch round iron and terminate on each end in a loop about 10 inches long, which is passed over the projecting ends of the draft key and secured in place by a cotter through the key on the outside of the loop. The crosstie timbers and wooden bolsters have to be cut out large enough to let the loop on end of draft rod pass through. The draft key is generally made ⅛ inch narrower at the ends where the draft rods bear, so that they may be reversed to take up any lost motion which is liable to develop. The draft spring *C C* is secured to the drawbar by means of the tailpin *D D*, which passes through the stationary follower plate *E E*, which is mortised into the draft-timbers and is held in place by the follower plate supports *F F*. Bolts through the draft timbers, back of the follower plate, tie them together. The slots in the draft-timbers through which the draft key passes are made about 1½ inches longer than the width of the key to allow for the compression of the spring, and a piece of iron, *G G* bent in the shape of an angle, is fastened in this slot for the key to strike against. For heavy cars, two springs are sometimes used with this draft gear, each one bearing on a stationary follower plate and one tailpin passing through both springs.

(To be continued.)

Third Annual Convention of the Association of Railroad Air-Brake Men.

The third annual convention of the Association of Railroad Air-Brake Men met at the American House, Boston, Mass., at 9 a. m., April 14, President Hutchins in the chair. Prof. George F. Swain, of the Massachusetts Institute of Technology and member of the State Railroad Commission, made an excellent opening address, in which he gave some figures illustrating the comparative safety of railroad travel. Much of this safety he attributed to the efficiency of the air-brake, and increased speeds with safety as great as at present he held can only be obtained by greater intelligence in the use f the brake, better maintenance, and a more general equipment of cars with it. Hence the importance of the association's work He also believed that it was actual economy for the railroads to spend money for freight brakes, because of the economies in train operation resulting therefrom, the safety and speed, and even the decreased headroom required for overhead bridges when men no longer have to walk on top of the cars of a train. In closing his remarks he welcomed the association to the city and expressed the hope that the convention would be a most profitable one.

President Hutchins replied for the association and then proceeded to read his address. He spoke of the rapid growth of the association to a membership of over 200 in three years, its good standing financially, the value of its work being recognized by the purchase of the reports of its proceedings to a phenomenal extent, and to the general interest taken in its work. He touched on high speeds and the high-speed brake, slack adjusters and other improvements, but he emphasized the fact that the great work of the association was to suggest and carry out in practice betterments in the instruction of the men who handle the air-brakes and to attain a higher standard in the maintenance of the brakes. To do this they needed the support of superior officials, instruction cars and test yards. Air-brake cars should be ordered to the head of the train and used regularly. Occasionally we hear of a road ordering its men not to use the air on freight trains. Instead of being an exhibition of old fogyism it may be a punishment for rough handling of trains. In such cases the order might eventually do good as the men will use the brakes even if they have to steal their use and at such times they will learn to handle them with care to avoid detection. In closing, he complimented the association on the promptness with which it handled its business last year and hoped it would do as well in this convention.

The Secretary's and Treasurer's reports showed the membership to be 210, and the funds in the treasury, March 31, to be $922.35. Since that date $118 had been received, making over $1,000 in the treasury. Practically the entire edition of last year's proceedings, 2,000 copies, had been sold except the small number distributed to the members.

Several communications were then read; one from the New England Railroad Club, invited the members to attend its meeting held on the evening of the 14th; the New York, New Haven & Hartford Railroad invited the association to make an excursion over its line to Plymouth; the Fitchburg Railroad invited them to visit the interlocking plant at its Boston terminals, and Sherburne & Company invited them to visit its offices and see a sanding apparatus worked in conjunction with the air-brake. These invitations were accepted, and the various trips taken at hours that did not interfere with the sessions of the convention.

The first report of committees to be read was that on "Piston Travel." This report is a voluminous but an admirable one. It discusses the loss of air in brake applications when the piston travels are uniformly long, the evils of various lengths of travel in the same train resulting in slid wheels, etc.; lost travel or that part of the travel resulting from slack in truck bolsters, center plates, boxes, deflecting brakebeams, etc.; and records the results of tests made on the St. Paul & Duluth Railroad, with cylinders having indicators attached. Rules are suggested for air-brake tests of trains arriving at division terminals. The report closes with the following recommendations:

1st. That yard tests be made from a 90 pounds train pipe pressure and a full service application, and piston travel adjustments, based on this, be made 6¼ inches for freight and 7 inches for passenger.

2d. That road tests be made from not less than 50 pounds pressure for freight and 60 pounds for passenger, and that readjustments be made to between 5 and 6 inches on freight and 6 and 7 inches on passenger where found less than 4½ inches on freight and 5½ inches on passenger, or where over 8 inches on either.

3d. That brake cylinders of such size be employed as recommended in Westinghouse Air-Brake Company's circular of Dec. 1, 1895, that total leverage necessary to employ may not be excessive.

4th That brake rigging (including beams) of sufficient strength be employed as will reduce deflection to a minimum.

5th. That lost travel due to truck construction and wear be as much reduced as possible.

The discussion was brief and was chiefly on the recommendation to use 90 pounds pressure for a yard test. Some claimed that it could not be obtained in many yards because of low steam pressure, and others doubted the wisdom of it, but the majority were in favor of it.

The next report to be considered was that on "Slack Adjusters." The value of a good slack adjuster was admitted but the committee had not found any device that could be pronounced perfect. It defined what an adjuster should do to fill the bill, the most desirable location for it, and the effect of the change in angularity of the brake levers as the slack is taken up. The committee conducted tests on this point to satisfy the doubting Thomas's and found the brake power was practically constant for large variations in the angularity of the levers.

The discussion brought out nothing new but served to emphasize the need of practical and successful devices of this kind.

The committee appointed to formulate a series of questions and answers on the air-brake next reported. Its report involved an immense amount of labor, but on account of its length—their being nearly 500 questions with their answers—it could not be discussed to advantage. It was disposed of by being ordered printed, and the committee requested to meet after the session to listen to any arguments which members might present to them on any part of the report.

The second day's business of the convention began with the reading of the report on "Water-Raising Systems on Sleeping Cars." The report describes the four different methods used up to date, and illustrates them. If the committee had done nothing else, its work would have been important, as information along this line has not been complete by any means. It recommends a method of testing, and closes with the following recommendations:

1st. That all water-raising systems using the first and second methods be changed to the third method.

2d. That a duplex air gage be placed in the wash-room of all sleeping cars using the water-raising system, and that the red hand be connected to the air pressure tank, and the black hand to the water tanks.

3d. That the reducing valve be regulated to permit but 20 pounds of air pressure on the water tanks.

4th. That the air pressure governor valve and the pressure reducing valve be given a more accessible location, and that "Governor Valve" and "Reducing Valve" be plainly stencilled on the door of the box containing them.

5th. That the air tank be drained by removing the drain plug each trip.

6th. That especial attention be given to the proper seating of non-return check valve 5.

7th. That the combination cock be kept ground in, and the water valves and pipes be kept tight.

8th. That a card of instructions be issued for the information and government of employees whose duty it is to care for the system.

9th. That an efficient system of maintenance be inaugurated that will insure the air-brake system from interference of the water-raising system; for your committee believes that by such measures only can the present relationship between the water-raising system and the air-brake system be safely continued.

In the discussion which followed Mr. Jesson, chairman of the committee, said that the changes made in the apparatus by the makers were so numerous that it was hard to keep posted on the latest; furthermore, such a thing as making the valves easily accessible, does not appear to be considered, and they are stuck in any out-of-the-way place. Mr. Nellis said that he had found several slid wheels caused by the device, and in each case they were due to leakage in the non-return check, valve 5, which in the operation of the brake practically added the volume of the air tanks to the auxiliary reservoir, and caused a high cylinder pressure. The sleeping-car employees, who ought to know something about the system, were more ignorant of it than any one else. It also developed during the discussion that the system was only used on Pullman sleepers and private cars, the Wagner company not using it because it had not found it satisfactory.

The next report to be read was on the "Economical Lubrication of Air-brake Cylinders." The committee gave the average cost of oiling and cleaning an 8-inch freight cylinder as 9 cents, and a 10-inch passenger cylinder as 12 cents, but it showed that where the freight cylinders were badly located the cost has risen as high as 60 cents. Its recommendations cover the same ground as the report, and are as follows:

1st. Air-brake cylinders on freight and passenger cars should never be oiled without at the same time being cleaned.

2d. Freight-brake cylinders should be cleaned once every twelve months and oiled with a heavy oil or light grease that is but little affected by changes in temperature, and will not gum within the period mentioned.

3d. Passenger-brake cylinders should be cleaned and oiled with a heavy oil or light grease at least once in twelve months, and not oftener than once in six months.

4th. While not absolutely necessary, there is an advantage to be gained in giving the piston a one-half turn every six months

5th. Greater care in the location of air-brake cylinders on freight cars, particularly coal, ore and other special cars, would result in a large reduction in the cost of cleaning the same.

In the discussion Mr. Pratt, of the C. & N. W. Railway, said that he was glad to see a period of one year recommended for cleaning of freight car cylinders, for his road had adopted that rule several years ago and were satisfied with the results Mr. McKee said that he had made a test of West Virginia well oil, Kent's compound, and another grease, in car cylinders on the Great Northern road; after five months the well oil had entirely disappeared, the grease whose name is not given had kept the packing in good condition, but the walls of the cylinder showed that lubrication would soon be necessary, while the cylinders to which Kent's compound had been applied were in as good condition as at the beginning of the test and were evidently good for the total period of twelve months recommended by the committee. Several other members testified as to the excellence of this compound for car and driver brake cylinders.

The report on "Maintenance of Passenger and Freight Brakes" was then read. It outlined what is required in air-brake test plants, illustrated methods of piping, also several portable stands for brake valves, a rack for testing triples, described methods and tools required for yard work, a form for reporting work on air-brakes, methods for getting the right leverage on cars and defect cards for brakes. The committee recommended clearing drain cups by disconnecting the union, swabbling the screen with a wire brush to loosen the dirt, and then blowing it out.

(*Concluded on page 88.*)

A Noiseless Compound Switching Locomotive.

As most of our readers probably know the Grand Central Station of the New York Central Railroad, as its name implies, is located in the center of New York, the approach to it being by an underground road which emerges into the open a short distance north of the station. The switching of the passenger trains required by its immense traffic must therefore be done in close proximity to resident streets on each side of it. Long ago the use of steam whistles, by switching engines, was prohibited, except in cases of great emergency. But even when whistles were not heard the sharp and loud exhaust of engines in starting heavy trains was and still is a great annoyance. During the past quarter of a century or more Mr. Buchanan, the Superintendent of Machinery of this line, and the architect of the celebrated 999, has experimented with and applied all kinds of devices to make the engines which are used in the streets of New York noiseless. These appliances had varying degrees of success, but they only partially mitigated the evil. The advent of the compound locomotive suggested to Mr. Buchanan a solution of the difficulty, and some months ago he designed the switching engine, which is illustrated herewith, an order for which was given to the Schnectady Locomotive Works, where it has recently been completed and is now at work on the tracks adjoining the Grand Central Station in New York.

As shown by the perspective view the engine has six coupled wheels, which are 51 inches in diameter, with a total base of 11 feet 6 inches. It is a two-cylinder compound, the high-pressure cylinder being 19 inches, and the low-pressure 29 inches in diameter by 24-inch stroke.

The special feature of the engine is the arrangement for making the exhaust noiseless. This consists of a receiver, which is attached to the middle of the cylinder castings, and is shown just below the extended smokebox in the perspective view, and also in outline in Fig. 2. In the inside it has a horizontal diaphragm which leaves a space below it, into which the exhaust steam from the low-pressure cylinder is discharged through the pipe below. The re-

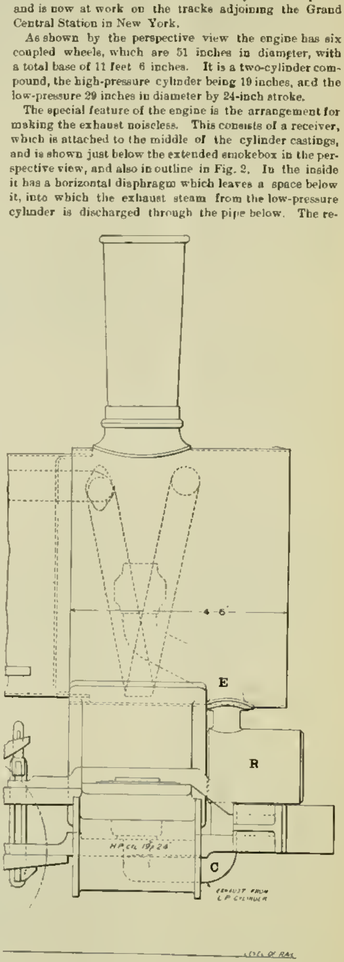


Fig. 2.—Outline of Front End of Locomotive.

ceiver also has two vertical diaphragms with holes shown in Fig. 3. The exhaust steam enters through the lower pipe, and passes under the horizontal diaphragm and through the holes in those which are vertical, and escapes up the chimney through the pipe at the top, which has a variable exhaust, shown by Figs. 4, 5 and 6—4 being a sectional view, and 5 and 6 end and plan views respectively. The upper end of this pipe has a revolving collar or sleeve on the outside of the central part. This sleeve rests on inclined guides, one of which is shown in Fig. 5. By turning this sleeve it is raised up through the action of the guides which thus leaves an annular opening between the sleeve and the inner pipe, whose size and area can be varied at pleasure. The central opening of the pipe always remains the same, but the total area for the escape of the exhaust steam is increased by the annular opening when the sleeve is raised up.

In the perspective view a relief valve is shown attached to the front end of the steam chest. This valve is connected to the receivers by a pipe, which is also shown in the view. A similar valve is attached to the high-pressure steam chest on the other side of the engine. The object of these valves is to maintain the pressure in the steam chests below a certain limit, and thus avoid an excessive pressure in either of the cylinders, and a consequent loud exhaust from that cause.

The engine is provided with Ashton blow back valves, which discharge the escaping steam into the tender.

The engine has been working very successfully for several

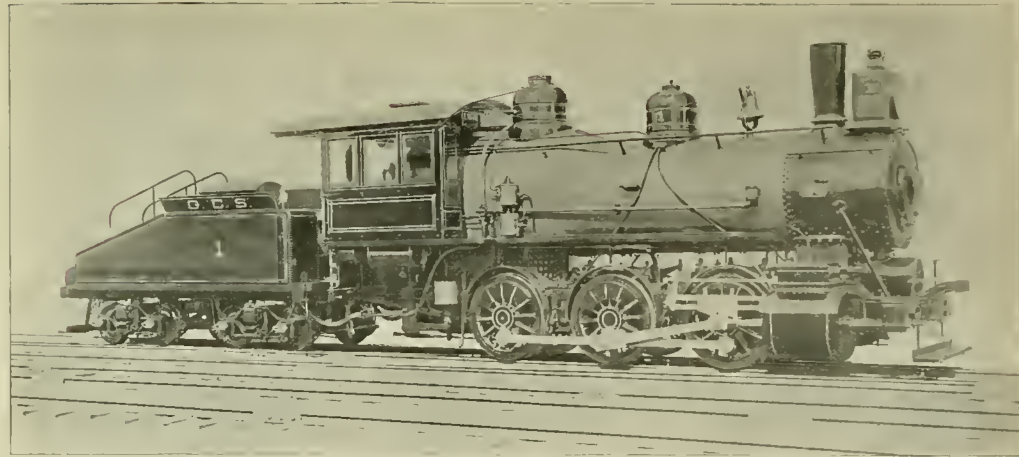


Fig. 1.

Compound Noiseless Switching Locomotive, for the New York Central & Hudson River Railroad.

Designed by Mr. Wm Buchanan, Superintendent of Motive Power. Built by the Schenectady Locomotive Works, Schenectady, N. Y.

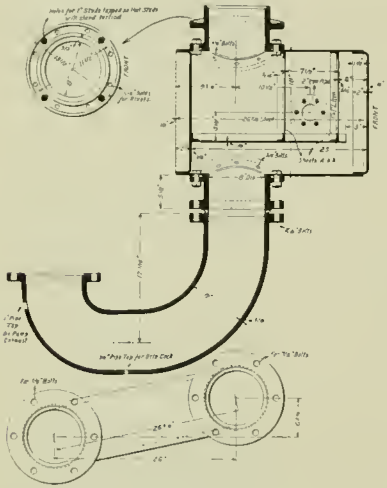


Fig 3.

Exhaust Box.—Compound Switching Locomotive

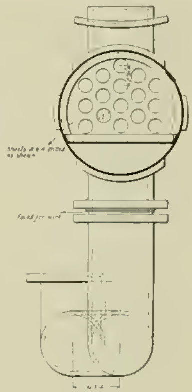


Fig 4

weeks, and while it cannot be said that it is at all times absolutely noiseless, it is true that the only time when any noise is heard is during the first two or three revolutions after starting when a very soft discharge is perceptible. After that a person a few yards away could not tell from the sound of the exhaust, that a locomotive was at work near them. This plan seems to afford the means of making the exhaust of locomotives so nearly perfectly noiseless that it will not be a cause of disturbance or annoyance to those who live, work or sleep in the closest proximity to them.

The engine steams very freely notwithstanding the fact that the exhaust is noiseless, but which seems to have sufficient effort upon the fire to maintain steam at the required pressure, which is 190 pounds.

The following are the principal dimensions of this engine:

General Dimensions.

Gage	4 ft. 8½ in.
Fuel	Anthracite coal
Weight in working order	125,000 lbs.
" on drivers	125,000 lbs.
Wheel base, driving	11 ft. 6 in.
" " rigid	11 ft. 6 in.

Cylinders.

Diameter of cylinders	29 R. H. 19 in. L. H.
Stroke of piston	21 in.
Horizontal thickness of piston	5¾ in. at hub, 4⅝ in. at rim.
Diameter of piston rod	3½ in.
Kind " " Packing	Plain rings of cast iron.
" " " rod packing	United States metallic.
Size of steam ports,	L. P. R. H. 20 in. × 1½ in. H. P. L. H. 18 in. × 1½ in.
Size of exhaust ports	L. P. R. H. 20 in. × 3 in. H. P. L. H. 18 in. × 3 in.
" " bridges "	1⅛ in.

Valves.

Kind of slide valves	Richardson balanced.
Greatest travel of slide valves	5½ in.
Outside lap " " "	L. P. R. H. ⅞ in. H. P. L. H. ⅞ in.
Inside lap " " "	L. P. R. H. $\frac{1}{16}$ in. H. P. L. H. $\frac{1}{16}$ in.
Lead of valves in full gear	$\frac{1}{16}$ in.
Kind of valve stem packing	United States metallic.

Wheels, etc.

Diameter of driving wheels outside of tire	51 in.
Material " " " centers	Steeled cast iron.
Tire held by	Shrinkage.
Driving box material	Steel cast iron
Diameter and length of driving journals	8 in. dia. × 9 in.
" " " " main crank pin journals	5½ in. dia. × 5 in.
" " " " side rod " " "	Main 5¾ in. dia. × 5 in. F. & B. 1½ in. dia. × 3½ in

Boilers.

Style	Wagon top.
Outside diameter of first ring	60 in.
Working pressure	190 lbs
Material of barrel and outside of firebox	Carbon steel.
Thickness of plates in barrel and outside of fire box.	Throat ⅝ in., balance $\frac{9}{16}$ in
Firebox, length	107$\frac{1}{16}$ in.
" width	42 in.
" material	Carbon steel.
" crown staying	5 in. × ¾ in. crown bars welded at ends
" stay bolts	1 in. dia
Tubes, material	Mild steel No. 11 W. G
" number of	271
" diameter	2 in.
" length over tube sheets	11 ft. 0 in.
Heating surface, tubes	1517.5 sq. ft.
" " firebox	182 sq. ft.
" " total	1709.5 sq. ft
Grate "	31.24 sq. ft
Exhaust pipes	Single, muffled through exhaust box
" nozzles	Variable 5 in. and 8 in. dia.

Tender.

Weight, empty	28,500 lbs.
Wheels, number of	8
" diameter	30 in.
Journals, " and length	3¾ in. dia × 7 in.
Wheel base	14 ft. 1½ in.
Tender frame	S. L. W. Standard, 6½ in. × 4 in. × ¾ in. angle iron
" trucks " "	channel iron center bearing
Water capacity	3,000 U. S. gallons
Coal "	3½ tons
Total wheel base of engine and tender	39 ft. 5½ in.
" length " " " "	52 ft. 1⅝ in.

The engine house is fitted with Westinghouse-American combined brakes on all drivers, tender and for train, magnesia sectional boiler covering, one 3-inch Consolidated muffled and one 3-inch Ashton blow back safety valve and central steel brakebeams.

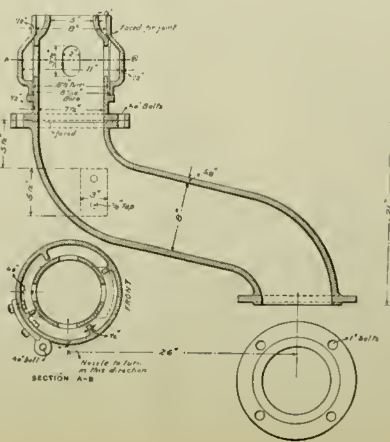


Fig 5.

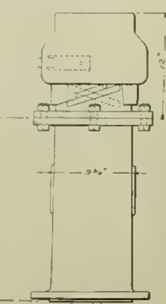


Fig. 6.

Variable Exhaust.—Compound Switching Locomotive

(Established 1832.)

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The third annual convention of the Air-Brake Men's Association was held in Boston last month, and we would direct the attention of our readers to the proceedings as summarized elsewhere in this issue. While our account is necessarily brief, the proceedings of the convention were of a high order, and the business was handled in a prompt and thorough manner. The reports presented exhibit the results of thorough and painstaking work, and are a credit to the association. They compare favorably with the reports to the other and older associations, and in view of the importance of the subjects with which the association has to do, and the excellence of the work it has thus far accomplished, it certainly merits a continuation of its rapid rate of growth in numbers and influence.

On English railroads the passenger traffic is divided into several classes, of which the third class is by far the most numerous and, according to all reports, the only profitable one. Of recent years the second class traffic has dwindled to almost nothing, and one would think the railroad officials would be glad to abandon it. But the Great Western and London & South Western roads have reduced the second-class fares with the expectation of inducing third-class passengers to patronize the second class. It appears to be the general belief that this step may delay, but cannot postpone indefinitely, the abandonment of the second class.

The bills now before Congress known as the "Wilson-Squire" bills, have for their object a revision of such rules and regulations of the navy as effect the status and authority of engineers. They provide for an increase in the number of the corps, which shall be in proportion to the increase of naval vessels; for the admission of graduates from civilian engineering schools to the corps, the establishment of an engineering experimental station, and the transfer to the engineer corps of certain engineering duties now in other hands. The fact is that the rules as they now stand, with certain unimportant exceptions, were framed when steam was only an auxiliary to sails, and when naval engineers had comparatively few responsibilities. Now their duties are such as to require, for the good of the service and justice to individuals, that their standing should be a higher one and their authority greater than at present. Judging from the past the establishment of an experimental station would be productive of much good, for it has been notably true of all experimental work undertaken by engineers in the employ of the government, that the time and money have been wisely expended. It appears that nearly every nation is or has been tardy in according to its naval engineers the status they deserve, but the agitation for justice to these officials has been strong and persistent. We trust that in the case of our own country it will result in much needed reforms.

The scheme of carrying the cars of the elevated roads of New York and Brooklyn over the bridge between the two cities so that passengers can make a continuous trip from any part of one city to any part of the other reached by the roads, is one that might meet with the approval of the traveling public if the details of the plan were more favorable to the two city governments. It is proposed that the roads shall pay a rental equal to the present earning power of the bridge railroad, the cities to pay for the changes at the terminals necessary for the through traffic, and the roads to charge only five cents for a ride from any station in one city to the further bridge terminal. The objection is urged that while this would eliminate the present bridge fare of three cents for such passengers as use both the elevated and the bridge, it would increase the fare from three to five cents to those who at present use the bridge only. The rental proposed is also held to be inadequate, especially on a lease for as long a period as 50 years, and it is pointed out that the cost of rearranging terminals and the payment of damages incidental thereto, all falls upon the cities, so that the railroads obtain the use of the bridge without any or but little initial outlay. The cry is also raised that the elevated roads will not operate the bridge road with the same regard to the safety of the public as has been exercised in the past, but that charge may surely be dropped in view of the record for safety already made by these roads in the conduct of their business. The plan might be a good one if the details can be arranged satisfactorily to all concerned, and the elevated trains sandwiched in between the regular bridge trains without confusion and delay, but it is doubtful if the percentage of the total traffic to be benefited by the change is sufficient to warrant the expense involved in the plan, unless other connections are made to the bridge in New York besides the east side lines.

The bill introduced into Congress making the metric system compulsory in this country after Jan. 1, 1901, has been sent back to the House committee and the probability of its being adopted in this session is very slim. It will be a good thing if it does not pass in its present form. We believe that the ultimate adoption of the metric system in this country is certain, but to make it compulsory and at such an early date is unwise and would work a hardship to many. Manufacturers who have considerable foreign business would probably reap sufficient benefit from it to offset the expense to them of the change, but there are many others who have no resulting advantages to look forward to, and these parties deserve more consideration than the bill mentioned gives them. If it is conceded that the adoption of the system will some time be an accomplished fact, then it is clear that the earlier the change is undertaken the less expensive it will be. The change should not be attempted without plenty of preparation, however, as without it the cost would be excessive and needlessly great. Such legislation as is desired in aid of this movement should be framed on more practical lines than the bill mentioned. The large manufacturers, if assured that only reasonable legislation was contemplated, would doubtless be able to suggest the lines on which a satisfactory law could be framed. They have a right to be heard in this matter, for upon them will come the great burden of a change. Expensive scales, templates, jigs, drawings, taps, dies, etc., would have to be changed, and this is one of the objections to a sudden and compulsory adoption of the system. But drawings become obsolete, and templates and special tools wear out, and if a reasonable period is allowed in which to effect the change, the manufacturing and engineering industries could doubtless provide a way for reducing to a minimum the confusion and expense incident thereto.

LOCOMOTIVE GRATES.

One of the subjects selected for investigation, and on which a report is to be made at the next convention of the Master Mechanics' Association, is that which forms the title of this article. Mr. H. Wade Hibbard is the chairman of this committee from whom, with the aid of his able coadjutors, an interesting report may be expected. There are some subjects in all departments of human activity and knowledge which are dragged along through years of vapid and fruitless discussion, which is productive of only negative results, and reveals little more than the fact that our knowledge concerning them is very limited. The subject of fire grates seems to be one of this kind. A vast amount of thought and ingenuity has been exercised in their design and construction, and innumerable patents have been taken out for inventions intended presumably to improve their operation, but the fact remains, that the combustion of coal is still a very imperfect and wasteful process. When converted into gas, very nearly perfect combustion of coal may be obtained, but when it is burned in its solid form a large percentage of its calorific value is wasted. Now this is due very largely, it is believed, to what may be called the "environment" of the fire, and it seems probable that very considerable economy would be possible if what may be called the contiguities of combustion were investigated and adapted to produce the result aimed at. Thus we are not aware that any exhaustive experiments have ever been made to show what is the most advantageous width of grate bars and openings between them for burning different kinds of coal. Obviously if the bars are too thick when fine coal is burned there will be an imperfect dissemination of air through the fuel, and if the openings are too wide much of the coal will fall through and therefore will not be burned. If on the other hand the bars are too thin and the spaces too narrow the bars may melt out and the spaces be clogged by ashes or cinders or both. It is thought that the student will look in vain through engineering literature for satisfactory information with reference to the best width of bars and openings for burning given qualities or grades of coal. An investigation to show what forms and proportions of grates are best adapted to burn different qualities of fuel, under different conditions, would involve much labor and expense and it could hardly be expected that a committee constituted like the one referred to could give the time nor has it the money for such research, but a distinct advance would be made if they should merely formulate our ignorance of the subject.

It might very properly be asked of the Committee what are the best proportion of grates for burning, say, buckwheat, steve, or run of mine anthracite coal, or the different grades of bituminous, such as Cumberland, Pennsylvania, and the Western coals, which clinker very badly. If in response to such enquiries the Committee would say that they don't know and cannot find out that anyone else does, it would be a gain.

Then there is the disputed question of the value of water grates for burning anthracite. On some roads these are being abandoned, and ordinary cast-iron grates are used instead. Of shaking grates for bituminous coal there is a great variety. Which are the best? The preferences which are felt by different master mechanics for certain types seem to rest on mere predilections, which have little or no sound facts or reasons to rest on.

Combustion, as every elementary book tells us, is a chemical combination of the carbon and hydrogen of the coal with the oxygen of the air. To effect this combination they must be brought into contact and there must be an igniting temperature. To produce perfect combustion it is therefore of the utmost importance that the grate should be so proportioned and constructed as to admit air to the coal so as to completely permeate the whole mass, and, what is perhaps of equal importance, is that the coal should be adapted to the grate. Every fireman knows that if the fuel which is thrown on the fire varies in size from large lumps to that which is almost pulverized, that not nearly such good results can be obtained as are possible if the large lumps are broken up and the coal is assorted, so that that which is burned is of nearly uniform size. In the latter case the grate can be adapted to the fuel which is used, and the supply of air may be much more uniformly distributed through it. This is impossible if large lumps are thrown on the fire, because the air can come in contact with the fuel so long as it is in the solid form only at its surface, and this is much greater in small than in large lumps in proportion to their bulk. Thus a spherical lump containing one cubic inch has very nearly five square inches of surface, whereas a lump containing ten cubic inches has only about two and a quarter square inches of surface per cubic inch of coal. It is therefore very much easier to bring the air into contact with the fuel when it is broken up into small pieces than it is if the fire is fed with large lumps. But if it is very fine it will pack closely, and then unless the grate has many small openings it is difficult to supply enough air to the whole mass.

To maintain good combustion it is essential, too, that the temperature of the fire should be kept above the point of ignition. If the temperature is reduced in any part of the fire below the point at which the gases will burn combustion is checked. Now, perhaps, few persons realize how much the temperature of a fire is reduced when fresh coal is thrown on it. It is not merely that the fuel must be heated from the external temperature to that of the fire, but as soon as the coal is heated it is converted into gas, and in that process a very large amount of heat is absorbed or becomes latent. Rankin called it the heat of gasification, which is very expressive. This phenomena is exemplified if we heat water in the atmosphere to a temperature of 212 degrees. To do this each pound of water will absorb 212 heat units, supposing its temperature was at zero in the beginning. If we continue to add heat the whole pound will be converted into steam, whose temperature will not at any time exceed 212 degrees. But to vaporize it besides the 212 units to heat the water it will require 966 additional units to convert the water into a gas.

This is the heat of gassification which is absorbed or becomes latent when the water is changed from a liquid to a gaseous form. A similar phenomena occurs when fresh coal is thrown on the fire and is converted into gas, the effect of which is to absorb heat from the fire. If the amount so fed to the grate is excessive the temperature about the fresh fuel may be re duced below the igniting point and combustion is thus partially or wholly arrested. The fuel and the grate should therefore bear such a relation to each other that the former may be distributed over the latter and so that air may be admitted through the whole mass of the fuel. One of the problems presented to the committee then, is to formulate such proportions for grates, as will most effectually accomplish this result, with different kinds of coal.

But there are other questions relating to what has been called the environment of the fire which ought to be considered. In Kent's excellent Mechanical Engineers' Pocket Book, he quotes Rankin, who says, "if disengaged carbon is maintained at the temperature of ignition, and supplied with oxygen sufficient for its combustion, it burns while floating in the inflammable gas, and forms red, yellow or white flame. The flame itself is apt to be chilled by radiation, as into the heating surface of a steam boiler, so that the combustion is not completed, and part of the gas and smoke pass off unburned." The temperature of water in a boiler with a steam pressure of 150 pounds per square inch is only 366 degrees whilst the temperature of gaseous flame is about 4,000 degrees it will therefore be seen as observed by Frederick Siemans "what a quenching effect the metal of the boiler, which is of course at the temperature of the water, has upon the flames." He also called attention to the fact that "when flame is brought into contact with any solid body, it is more or less quenched, according to the substance, size and temperature of the body. Take any ordinary illuminating gas flame, such, for instance, as a batswing, and place a glass rod or tube into the middle of it, the flame will immediately burn dull, and a large quantity of lamp-black will be deposited on the piece of glass. This action is most marked when the rod is cold, but takes place, though in a less degree, at any temperature, for the reason that the material to be heated is necessarily always at a lower temperature than the flame, also owing to the disturbance in the combustion caused by contact of the solid substance with the flame." Continuing, this distinguished authority announces this important principle in relation to combustion—"experiments I have made," he says, "establish the following most important fact, namely, that a good flame, or in other words, *perfect combustion can only take place in an open space or in one of sufficiently large size to allow the gases to burn out of contact with solid material.*" This principle, it is believed, is of very great importance in the combustion of coal especially in locomotives, many of which necessarily have a limited amount of space in their fireboxes. If these are too narrow, the flame must come in contact with the sides, and if they are shallow with the crown-sheet. Every fireman has observed how prone the fire in a locomotive firebox is to become dead along the sides and the front and back ends of the firebox.

The fire here is in contact with the cold surfaces, and the flame comes in contact with solid material. It would seem to be wise, then, to widen the fireboxes of locomotives, whenever this is possible, and give them ample depth. This, however, can only be done in new designs, and should undoubtedly be aimed at in all cases. But can nothing be done in the existing forms and proportions of fireboxes? The deadening effect referred to is due to the contact of the fuel and the fire with the sides of the firebox. This can be avoided by constructing the grates with dead plates or firebrick all around them and between the open part and the firebox plates. If these are inclined somewhat steeply they will keep the fuel away from the cold plates, or if made flat they will speedily be covered with ashes or cinders which will have the same effect. Combustion in a very shallow firebox would undoubtedly be improved by lowering the grate below the sides of the firebox when this is possible. The principle to which it is intended to direct the attention of the committee is that enunciated by Mr. Siemans, and the object to be aimed at is to construct grates so as "to allow the gases to burn out of contact with solid material," as far as that is possible.

Another matter is also worthy of their attention—that is, the rate of combustion on grates. It does not seem to be at all certain that the principle which has been hastily assumed that the slower the combustion the greater is the economy. There probably is some rate for locomotives which is more economical than any which is slower or faster, and it may be that this rate has some relations to the speed and the loads hauled. Be this as it may it seems very probable that a grate which is sufficiently large to be economical when the maximum demands are to be made on it, would be too large for economy when the engine is not consuming so much steam. This suggests a grate of variable size, which perhaps is worthy of consideration by the committee.

There has lately been some discussion with reference to the slope of grates in marine boilers and it has been advocated that instead of sloping downward from the furnace doors they should incline the reverse way. In locomotives sloping grates have always been made lower at the front end than behind. Is it quite certain that this is the best form of construction? In some kinds of engines this is essential in order to get the rear axle under the firebox, but in some other types it would be a distinct advantage to have it higher in front.

A collateral subject relating to grates is that of furnace doors. There can be no doubt of the fact that having the furnace door open so large a portion of the time when a boiler is worked the hardest has a very deleterious effect upon the fire. Probably most engineers would agree that the steaming capacity of a locomotive boiler would be greatly diminished if the door was kept open all the time. There is every reason for believing that the deleterious effect of having the door open is in proportion to the time it is open. In ordinary hand firing probably the door is open one third of the time, the effect of which is just one-third as bad as though it was open all the time. Is not some form of automatic opening door possible or some way of feeding coal to the fire without opening communication wide for the admission of cold air?

The Committee has an opportunity of making an interesting and valuable report.

TIMBER.

AN INVESTIGATION OF ITS CHARACTERISTICS AND PROPERTIES.

Probably comparatively few of the practical railroad men of the country are aware of the extent of the work which has been undertaken by the Forestry Division of the United States Department of Agriculture, under the charge of the able chief of that division, Mr. B. E. Fernow. The results of this work have been given to the public in a series of bulletins, whose value has probably been appreciated by only a few of those who would be most benefited by the wealth of information which these bulletins contain. The conception of this work dates back about ten years, when Mr. Fernow was first appointed to the office he has since held. For several years no investigations were undertaken because the government authorities would not supply the means for equipping a laboratory for making them. In 1890 Prof. J. B. Johnson, of the Washington University in St. Louis, offered to co-operate with the Forestry Division, and those in charge of it were enabled to enter upon the mechanical tests in connection with the physical investigations going on at the laboratory in Washington. Since then the work has progressed by fits and starts, as best it could be forwarded with the limited facilities which were supplied by those who control appropriations for such purposes.

The investigations have been chiefly in relation to Southern timbers owing to the interest taken in that branch of the great subject by Southern railroad companies, and their willingness to carry material to be tested free of charge. Over 20,000 tests of Southern pines were made, and these were so thoroughly carried out that there does not now seem any reason why they need ever be tested again. Another series of tests of hardwoods and cypress have been made which, although not carried out in so extensive a scale as those on the Southern pines, will, nevertheless give a better index of the strength and qualities of these species than has ever been obtained before. These are now being put into form for publication.

The object of this work is not only to give more definite knowledge of the range of strength values of our timber, but more especially to establish rules of inspection which will enable a wood consumer to select his material with knowledge as to its behavior and quality. It will thus be seen that this information will be of immense value to all consumers of wood, and this includes nearly the whole community, but it especially commends itself to railroad companies, who are perhaps the largest consumers of wood in the country.

It is impossible in a short article like this to give anything like a complete idea of the scope of the work which has been laid out. It may be said, in the first place, that to give reliable information concerning the character of any species of timber it is essential to test and examine a large number of specimens of known origin, with information concerning the circumstances of their growth, so as to learn the causes of variation in their properties. It is expected by such a series of investigations to answer some of the following questions:

"What are the essential working properties of our various woods and by what circumstances are they influenced?

"How does age, rapidity of growth, time of felling and after treatment change quality in different timbers?

"In what relation does structure stand to quality?

"How far is weight a criterion of strength?

"What macroscopic or microscopic aids can be devised for determining quality from physical examination?

"What difference is there in wood of different parts of the tree?

"How far do climatic and soil condition influence quality?

"In what respect does tapping for turpentine affect quality of pine timber?"

A very complete system has been organized for collecting specimens and making the tests, the results of which have been published in the series of bulletins already referred to.

There has been difficulty in persuading the government authorities that this is a class of work which is appropriate for a Government office that is, that it has a sufficient general interest and value to the community to justify the expenditure of public money. As has been pointed out, such an investigation to have the value and scope which it should have, and to accomplish the results aimed at, requires that a very large number of tests be made, with careful consideration of all the attending data. This necessarily involves considerable expenditure. A bill to appropriate $40,000 for these tests has been in Congress for several sessions without action. The money expended in making these investigations has been largely derived from the general funds appropriated to the Forestry Division of the Department of Agriculture, but there is now a disposition to abandon the work unless favorable action can be obtained on the bill referred to above. Those interested in the subject—and this includes nearly all engineers, railroad managers, and especially master car builders, architects, etc.—may aid in securing the legislation required to continue the investigation by writing to their Congressman commending the work of the Forestry Division and urging action on the appropriation required to continue and complete the investigation and tests. It would be a public misfortune if these investigations were not continued and if the thorough work of Mr. Fernow was left incomplete.

Notes.

In the April number of the *Stevens Indicator* Mr. Wm. Kent has an article on the heating value of the volatile portion of bituminous coal, in which he urges the need of data obtained from actual tests, and outlines a series of experiments which he thinks would add greatly to the available knowledge on this subject. He then says: Two questions upon which the proposed research may throw some light are: (1) What is the character of the volatile matter of the more highly bituminous coals; and (2) may it not be commercially practicable to get rid of the least valuable portion of this volatile matter, by some kind of coking process, at the coal mines, and save freight not only upon it, but also on so much of the fixed carbon which is wasted in the ordinary boiler furnace in the operation of distilling the volatile matter? If any of the Western coals containing high percentages of oxygen contain it in such chemical combination that it can be removed at a comparatively low temperature at the coal mine, it would appear that a partial coking of these coals at the mine would be commercially practicable. Even if the oxygen cannot be removed except at a high temperature, it may be found that it carries with it in distillation the valuable by-products which are obtained in the Otto-Hoffman and the Semet-Solvay coking processes, and that their extensive introduction in the West would pay. There is a possibility of fractional distillation of Western coals giving three valuable products, first, gas approximating in composition to natural gas or methane, CH_4, which could be utilized in factories within a certain distance; second, ammoniacal tar waters, containing valuable substances for use as fertilizers or in the chemical industries; third, smokeless coal or coke, which would be the final solution of the smoke problem in the Western cities.

An official trial has also recently been made of the Belleville boilers constructed by Messrs. Maudsley Sons & Field, at their works in Greenwich, for the new twin screw steamer *Kherson*, built for the Russian volunteer fleet. The following were the conclusions drawn therefrom:

"During the first three hours the evaporation was equal to 9.2 pounds of water per pound of coal burned, and for the first six hours 9 pounds of water. At the end of the sixth hour the fires were cleaned out, and again at the end of the tenth hour, and no allowance was made in the weight of coals. The mean results, it will be seen, are 8.88 pounds of water evaporated per pound of coal, and 21.43 pounds of coal burned per square foot of grate area."

An account of some interesting researches on the value of paints for ironwork, made by Prof. J. Spennrath, has recently been published in the *Deutsches Bauzeitung*. As one result of these, Professor Spennrath concludes that none of the metallic oxides commonly used combine chemically with linseed oil. The drying process depends exclusively on an absorption of oxygen by the oil, which is facilitated by the presence of the pigment in a purely mechanical way. The value of the different pigments used varies. Thus, zinc white, when used for outside work, rapidly swells to double its previous volume, owing to the absorption of carbonic acid gas and water. Sulphuretted hydrogen will cause red or white lead to act in a similar way, but, when pure, Professor Spennrath considers these two latter pigments satisfactory. Carbon paints are very stable, as is heavy spar, but the covering power of the latter is small. In order to test the relative durability of various paints, sheets of zinc were coated with a number of different kinds. The zinc was then dissolved away by acid, leaving a film of paint. All these films, it was found, could be destroyed by the action of dilute nitric or hydrochloric acids, while the vapors of sulphuric and acetic acids acted similarly. Alkaline fluids and gases also destroyed the paints rapidly. Pure water was found to be more injurious than salt water, and hence the destructive action of sea water is to be attributed mainly to the mechanical effects of wash. Hot water was found to act more rapidly than cold. The most important discovery made was, however, the great influence of temperature. Films, similar to those already described, completely lost their elasticity and became brittle when exposed to a temperature of 203 degrees Fahrenheit. There was, at the same time, a large contraction. Similar effects are produced by prolonged exposure to considerably lower temperatures. Blistering he finds to be due to the inner coat of paint being so thick that it has not hardened thoroughly before the second coat is applied.—*Practical Engineer.*

The elevation of the tracks of the Pennsylvania road through Newark, N. J., will involve an expenditure of $3,000,000, and will require about five years to finish the work. The elevation will be about four miles long, and where it crosses the Passaic River a four-track bridge will be erected. The elevated tracks will be on a bank. The average depression of the streets will be about 5 feet, and the average elevation of the tracks about 15 feet. The plans for the work are complete.

The Pennsylvania Railroad has contracted for two new ferryboats for service on its Twenty-third street ferry. This new ferry, about to be established, is much longer than the present ones, and to reduce the time of the trip the new boats will be faster than any now in the service of the company. They are to be capable of making 15 miles per hour. This speed has necessitated more powerful engines, and they present some novel features. The boats are to be 206 feet long over all and 65 feet beam, and will have two decks, being in these respects identical with the company's standard boats. They will be propelled by twin screws at each end (or four screws in all), each shaft being driven by a set of compound condensing engines, with one 20-inch high-pressure cylinder and two 32-inch low-pressure cylinders, all of 24-inch stroke. The three cylinders will be connected to cranks 120 degrees apart. Steam will be furnished by Ward water-tube boilers under assisted draft of ½-inch of water. The steam pressure is to be 150 pounds per square inch. The boats are to be fitted with steam steering gear, lighted by electricity and heated by the indirect system, the fans for which will be driven by electric motors. Many of our readers are familiar with the screw ferryboats in service on the Hudson River, in which the engines drive a shaft extending the whole length of the boat and having a screw at each end. The new boats have practically the same type of machinery, but it is doubled, so as to get the increased propelling power without great draft. One of the boats is to be built at the Cramp shipyards and the other by Chas. Hillman Shipbuilding Company.

In maintaining high speeds over long distances it is important to reduce the number of stops and the length of each stop to a minimum. Stops at water stations are among the most lengthy, and it is a wonder that means for taking water more quickly do not receive more attention. The Chicago & Northwestern road has realized the importance of this matter and has put in several new water-station outfits, in which 10-inch or 12-inch standpipes are used. All valves and connections are equally large, and as a result it has been found that water from a 50,000-gallon tank set 23 feet above the ground can be delivered through a 12-inch stand-pipe 300 feet away at the rate of 4,000 gallons per minute; and through a 10-inch stand-pipe located 800 feet away and connected to the tank by a 12 inch main at the rate of 3,200 gallons per minute. We understand that tank stops, at which over 3,000 gallons were taken, have been made in which the train got away inside of three minutes, as against the five to seven minutes ordinarily consumed. In this case time is saved to every train taking water at the station by an expenditure that we venture to state is less per minute of time saved than can be effected in any other way.

Hopper Gondola Car of 60,000 Pounds Capacity.—Central Railroad of New Jersey.

Through the courtesy of Mr. C. A. Thompson, Superintendent of Motive Power of the Central Railroad of New Jersey, we publish herewith the drawings of that company's latest hopper car of 60,000 pounds capacity. The car is 30 feet long outside of the end planking, 8 feet 11 inches wide outside the planks and the sides are 3 feet 11 inches high. The total length of the car over the dead blocks is 33 feet 2 inches and the width over the sills 8 feet 11 inches.

The frame consists of four continuous sills, the center sills being 5 inches by 9 inches in section and the side sills 5 inches by 12 inches. At the beginning of the hopper there are transverse blocks 5 inches by 9 inches in section, fitted between the center and side sills, and from these to the end sills there are short stringers. Directly in line with the dead blocks are "bumper braces" extending from the end sills to the body bolsters. An interesting feature of this supplemental framing is the use of pocket castings at their ends. In Fig. 2 we give one of these castings in detail. They are of cast iron, and, being fitted to the face of one timber and receiving the end of another, they take the place of mortises and tenons, and facilitate the removal of those timbers in repairs. The 5-inch by 9-inch "bridge blocks," to which the hopper doors are hinged, are also framed to the sills by the aid of these pocket castings. From a point just back of the draft gear and extending almost to the center of the car, the space between the center sills is filled in solid by a timber 9½ inches by 9 inches in section.

The hoppers are supported by heavy wrought iron straps that extend across the sloping bottom and up the inclined sides to the side sills where they are firmly bolted. The hopper doors are held by a mechanism that is entirely un-

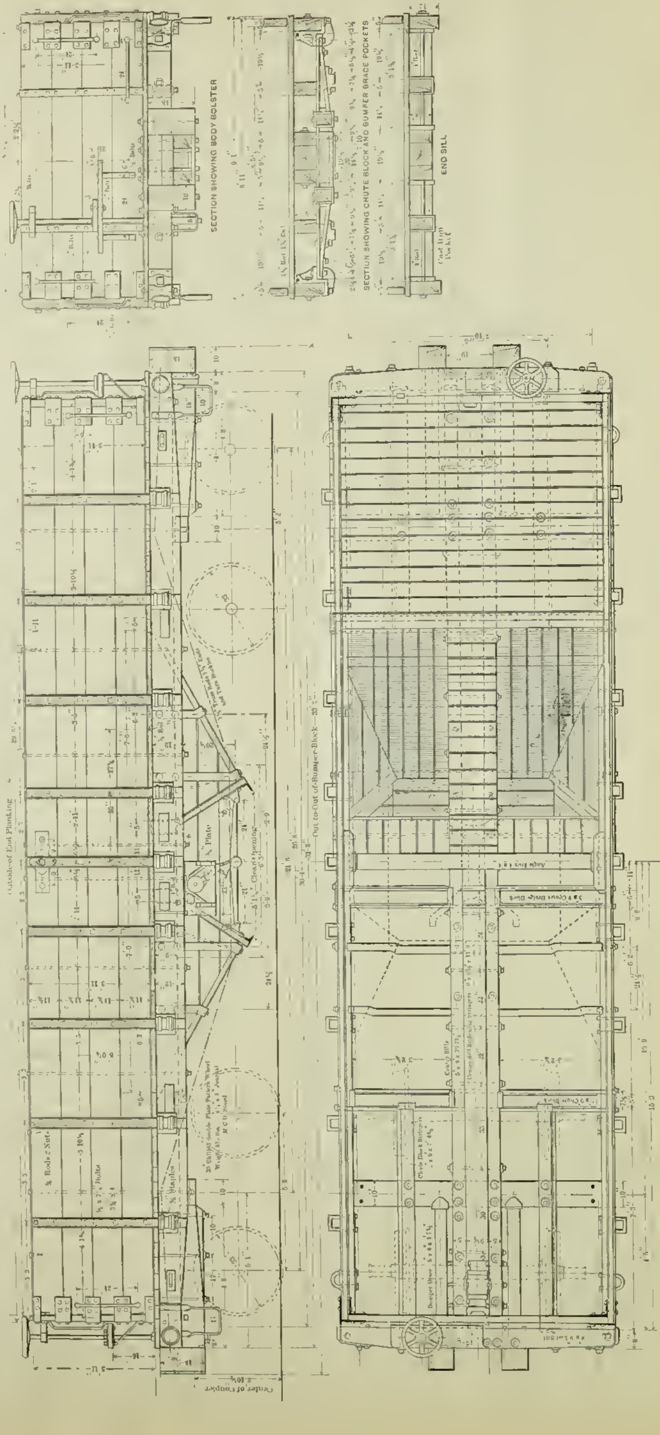


FIG. 1. HOPPER GONDOLA CAR OF 60,000 POUNDS CAPACITY.—CENTRAL RAILROAD OF NEW JERSEY.

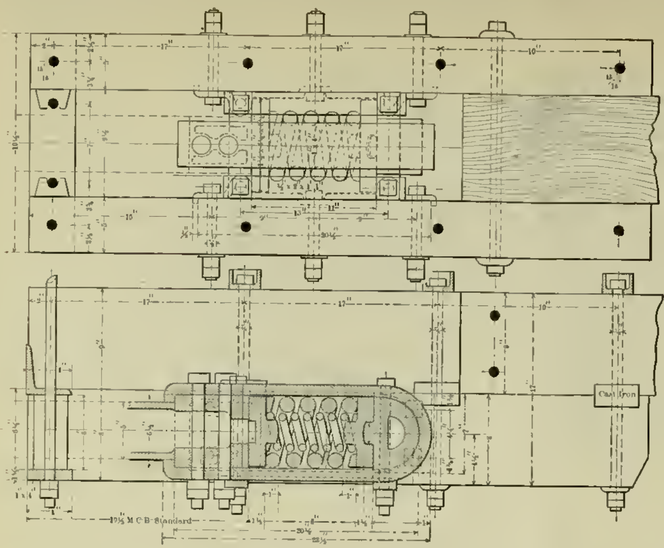


Fig. 3. Draft Rigging for 60,000-Pounds Gondola Car.

der the floor and between the doors, and is free from all danger of sticking. It consists of a toggle which is held down by cams on a shaft carried in the plate shown extending down from the side sill. This shaft is locked by a suitable pawl and gravity dog.

The presence of hoppers makes it impossible to use more than two truss rods, but these two are of liberal dimensions, being 1¼ inches in diameter with 1½-inch ends. They have been given a deep camber.

The draft rigging is of the Schoen pressed steel type and is illustrated in Fig. 3. The stops, it will be seen, are in

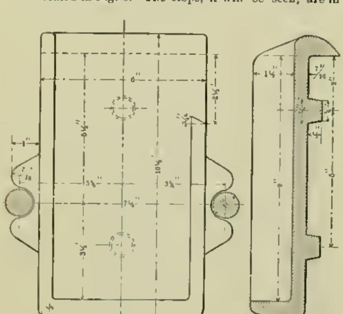


Fig. 2. Pocket Castings.

one piece of pressed steel on each timber and are set in at the center and bent over at the ends to mortise into the timber. They are each secured by six bolts. The draw bar strap is Mr. Thompson's design and is made semi-circular at the inner end and a cast-iron block fitted between it and the follower. This makes a stronger strap than the common construction. A 4-inch angle iron is fitted into the face of the end sill to take the impact of the bracket of the coupler.

The body-bolsters are composed of 10-inch by 1 inch top plates and 10-inch by 1¼ inch bottom plates. The depth at the center is 6¼ inches. The ends of the top plates are bent over the ends of the lower plates, and it will also be seen from the section in Fig. 1 that the truss rod saddle castings are interposed between the ends of the bolsters and the side sills.

The car is carried on Fox pressed steel trucks, air-brakes and M. C. B. type of couplers.

The St. Louis Convention of the American Society of Mechanical Engineers.

The American Society of Mechanical Engineers will hold its semi-annual convention at St. Louis, Mo., May 19 to 22, 1896. The headquarters of the society and its place for holding sessions will be at the Southern Hotel. The list of professional papers to be read at this session is as follows:

KEEP, WILLIAM J.: Strength of Cast Iron.
KENT, WILLIAM: The Efficiency of a Steam Boiler. What is It?
ELDRIDGE, A. H.: Tests of a Four-Cylinder Triple-Expansion Engine and Boiler.
HALE, R. S.: Determining Moisture in Coal.
KETTELL, CHARLES W.: A Study of the Proper Method of Determining the Strength of Pump Cylinders.
GOSS, W. F. M.: The Effect upon Diagrams of Long Pipe Connections for Steam Engine Indicators.
CARPENTER, R. C.: A New Form of Calorimeter.
HOFFMAN, J. D.: A Hydraulic Dynamometer.
HENDERSON, GEORGE R.: Spring Tables.
WHITHAM, JAY M.: Effect of Retarders in Fire Tubes of Steam Boilers.
WHITHAM, JAY M.: Experiments with Mechanical Stokers
THURSTON, R. H.: Superheated Steam.
BRYAN, WILLIAM H.: Western River Steamers.
ALBERGER, L. R.: A Self-Cooling Condenser.
PORTER, H. F. J.: Hollow Steel Forgings.
HUTTON, F. R.: A Classification and Catalogue System for an Engineering Library.
MURRAY, THOMAS E.: A Steel Plate Fly-Wheel.

The social features of the programme and the excursions planned give promise of much enjoyment and profit.

The National Convention of Railroad Commissioners.

The eighth annual convention of Railroad Commissioners will be held at the office of the Interstate Commerce Commission, No. 1317 F street (Sun Building), in the city of Washington, D. C., on Tuesday, May 19, 1896, at 11 o'clock in the forenoon. The Railroad Commissioners of all States, and State officers charged with any duty in the supervision of railroads, are requested to attend and participate in the discussion of such topics as may come before the convention. The Association of American Railway Accounting Officers is also invited to attend, or send delegates to the convention, and join in the consideration of such questions of special interest to their association as may arise.

At the last convention committees were appointed on the following subjects and directed to report to the next convention:

1. Railway statistics.
2. Uniform classification.
3. Legislation.
4. Protection of public interests during railway labor contests.
5. Regulation of State and Interstate electric railways.
6. Powers, duties and actual work accomplished by the several State Railroad Commissions during the year.
7. Government control and government regulation of railways.
8. Safety appliances.
9. Pooling of freights and division of earnings.

The following resolution was adopted at the last meeting: "That a committee of five be appointed to select officers for and subjects to be presented at the next annual convention of this association, to solicit papers upon the same, either from members of the association or from those not connected with the organization, and to prepare, as far as possible, a programme of proceedings;" and the following committee on organization and programme for the next convention was named: George M. Woodruff, of Connecticut; G. G. Jordan of Georgia; Ira B. Mills, of Minnesota. E. C. Beddingfield, of North Carolina; Edward A. Moseley, Secretary of the Interstate Commerce Commission.

Members of former conventions are entitled to participate in the discussion of subjects at the coming meeting. The various State Commissions should be represented by full boards, as far as possible, and to that end all Railroad Commissioners are earnestly requested to attend the coming meeting.

Personal.

Mr. Julian R. Lane has been appointed General Manager of the Macon & Birmingham Railway.

Mr. N. E. Matthews has been appointed Purchasing Agent of the Ohio Southern, vice C. H. Roser.

Mr. John T. Clark has been appointed Master Mechanic of the Northern Ohio, with headquarters at Delphos, O.

Mr. C. H. Barnes has been appointed Division Master Mechanic of the Boston & Albany at West Springfield, Mass.

Mr. Howard James has been appointed Purchasing Agent of the Eastern Railway of Minnesota, with offices at Duluth.

Mr. Alfred Atwood has been appointed Locomotive Superintendent of the Mexican Railway to succeed Mr. E. G. Evens, resigned.

Mr. Wm. H. Taft, for some time past Acting Superintendent of Motive Power of the Boston & Albany, has been appointed Superintendent of Motive Power.

Charles H. Burnett has been appointed Purchasing Agent of the St. Lawrence & Adirondac Railway, with office at No. 51 East Forty-fourth street, New York.

Mr. W. W. Finlay has resigned the Third Vice-Presidency of the Southern Railway, and it is said he will take a position of responsibility on the Great Northern.

Major Edward Leslie, whose name is well-known to railroad men through the rotary snow plow that bears his name, died suddenly at Paterson, N. J., March 26.

During the absence of President Samuel Spencer in Europe, Mr. A. S. Andrews, of Raleigh, N. C., First Vice-president of the Southern Railway, will act as President of the company.

Mr. Thomas B. Purves, Jr., Master Mechanic of the Boston & Albany Railroad, has been appointed Superintendent of Rolling Stock, and will have charge of both the car and locomotive departments. His headquarters are in Boston, Mass.

Mr. David B. Carse, General Manager of Greenlee Bros. & Co., Chicago, manufacturers of wood working machinery, has returned from a three months' trip in Europe, where he visited railroad shops and car works.

Mr. T. D. Kline, who was reported as having accepted the general management of the Interoceanic Railway of Mexico, has declined the position, and there is no truth in the report that he is to resign as General Superintendent of the Central of Georgia.

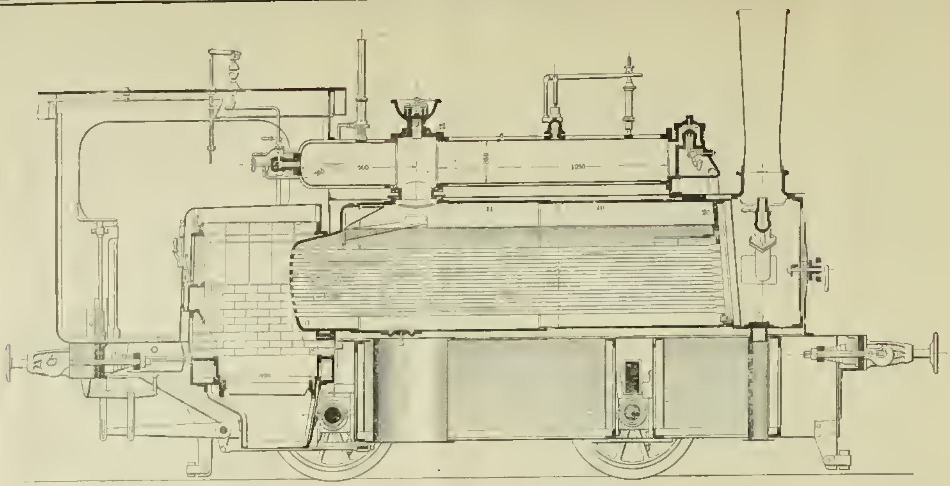
Mr. F. W. Morse, for some years Division Master Mechanic of the Wabash Railroad, with headquarters at Fort Wayne, Ind., has been appointed Superintendent of Motive Power of the Grand Trunk road. He succeeds Mr. Herbert Wallis, who has resigned from that position, which he held since 1873.

Mr. George T. Anderson, late Superintendent of the Indiana Car and Foundry Company, has been appointed Superintendent of the Chicago, New York & Boston Refrigerator Company, vice F. W. Brazier, lately appointed General Foreman of the car department of the Illinois Central. Mr. Anderson has charge of all the line cars, as well as the shops at Fifty-first street, Chicago.

Mr. C. M. Higginson, after many years of service on the Chicago, Burlington & Quincy, has gone to the Atchison, Topeka & Santa Fe as assistant to the President. Mr. Higginson has done much on the Burlington system to establish uniformity and economical co-operation between different departments. He is a civil engineer and has had experience also in the locomotive and accounting departments, and is well fitted in ability and experience to fill the position to which he has been called.

Mr. James S. Drake, General Superintendent of the New Jersey & New York Railroad, died at his home at Hillsdale, N. J., on April 16. Mr. Drake began railroad service as apprentice on the Grand Trunk 40 years ago. He was afterward Master Mechanic of the Portland & Rochester road in Maine. Later he occupied a similar position on the New York Elevated Railroad, and in 1879 went to the New Jersey & New York as Master Mechanic. In 1880 he was appointed Superintendent also, and for some years has given all his time to the latter office.

Mr. Robert Miller, General Superintendent of the Michigan Central, is hereafter to be Superintendent of Motive Power and Equipment. Mr. R. H. L'Hommedieu, former Assistant General Superintendent, becomes Mr. Miller's successor as General Superintendent. Mr. Miller's first position on the Michigan Central road was as Master Car Builder, with charge also of buildings and waterworks, which position he occupied for eight years. In 1884 he was transferred to the transportation department, becoming in that year Assistant General Superintendent, and holding the office six years. In taking this new posi-



Locomotive With Mason-Work Firebox.—Fig. 1.

tion he therefore returns to a line of work in which he was engaged for years.

Mr. Herbert Wallis has resigned from the position of Mechanical Superintendent of the Grand Trunk, after a service of 24 years in that capacity. Mr. Wallis received his early mechanical training at the Derby shops of the Midland Railway. In 1866 he became foreman in its Bradford shops, and in 1871 accepted the position of Assistant Mechanical Superintendent of the Grand Trunk Railway. In 1873 he was placed at the head of the department. As illustrating the growth of the business since Mr. Wallis has been Mechanical Superintendent, it is stated that the road's locomotive equipment has grown from 353 to 808 engines, its passenger cars from 352 to 916, and its freight car equipment from 8,078 cars to 23,888 cars. Because of tariff restrictions, the road has manufactured many of its supplies that under other conditions would have been purchased, and a large variety of work has therefore been under his care. Mr Wallis is highly esteemed in railroad and engineering circles. He was recently elected president of the Canadian Society of Civil Engineers.

Mr. Charles E. Smart, General Master Mechanic of the Michigan Central, died at his home in Jackson, Mich., on March 29, after a short illness. Mr. Smart had been General Master Mechanic of the Michigan Central since 1885. He was born at Rochester, N. H., in 1840, and after serving as machinist apprentice in the East, went into the railroad shops at Niles, Mich. In 1860 he went to Vicksburg, Miss., working on the railroad between Vicksburg and Jackson, and shortly afterward went to Cuba in charge of the machinery on a sugar plantation. He returned to the United States, and in 1863 worked for a short time in the Quincy shops of the C., B. & Q. R. R. After another short period spent in Cuba he accepted the position of foreman of the South Bend Iron Works, where he remained until 1872, when he became a locomotive engineer on the Missouri, Iowa & Nebraska road. In 1874 he went to the Michigan Central as a locomotive engineer, and a year later became Master Mechanic of the Mackinaw Division in charge of the locomotive and car departments. That office he held for 10 years, when he became General Master Mechanic of the road.

The Butler & Pittsburg Railway Company was organized in the offices of the Carnegie Steel Company April 24th. J. T. O'Dell, of Boston, was chosen President. Andrew Carnegie and T. M. Carnegie, Jr., are directors. The Secretary was authorized to at once advertise for bids for construction of track and road bed. When completed the new road will be merged into the Pittsburgh, Shenango & Lake Erie Railroad. The Carnegie Steel Company guarantees the road at least three million tons of ore a year.

The contract for building the new passenger station at Providence, R. I., together with the office and express buildings on either side of the station, has been let to Hortons & Hemmenway, of Providence, for $425,000. The contractors expect to begin work immediately, and are under obligation to have the buildings under roof by Jan. 1. The basements of the three structures will be built of Leete's Island granite, and the walls will be of buff brick with sandstone trimmings. The floors of the waiting-rooms and corridors will be marble in mosaic patterns, and the woodwork will be of quartered oak. The inside walls will be of enameled tile.

Locomotive Boiler with Mason-Work Firebox.*

BY A. SOCHER, CHIEF ENGINEER OF THE ROYAL AUSTRIAN STATE RAILWAY IN LARBACH.

In designing the locomotive boiler illustrated by Figs. 1 and 2, the first and main object that was kept constantly in view was to obtain the greatest possible safety against explosion.

That the boiler with a stayed firebox, built upon the Stephenson designs, is only partially satisfactory in this respect will be readily acknowledged Even if the locomotive boiler does not occupy a prominent place in the statistics of boiler explosions, it is simply that we have the conditions under which it works to thank, for railroad officials exercise the most painstaking oversight and most careful inspection in connection with their boilers as being a matter of the utmost importance to themselves. In spite of this, however, bad water, sulphurous coal, etc., give many unpleasant surprises to boiler inspectors. Hence, there is no doubt but that there is an actual and pressing necessity for a safer construction of locomotive boilers.

Noteworthy efforts have been made of late years in this direction without as yet having fully satisfied all of the conditions of this exceedingly difficult problem. The reason for this may lie in the fact that the designs which have been brought out follow too closely the common type of boiler, by which a comparatively satisfactory reconstruction of the existing boiler becomes possible, but it will be confined between limits that are cramped and well defined as to the form which it shall assume.

From the following description it will be seen whether, or to what extent, this boiler is an improvement in form over the one that has just been denounced, and which is the prevailing type of the day.

The construction of locomotive No. 8822 of the Royal Austrian State Railway was completed and the engine put into service in April, 1894.

The construction of the boiler is exceedingly simple. The shell or barrel of the boiler ending in a smokebox, and the front tubesheet, are worthy of no particular attention. The stayed portion of the boiler has been entirely discarded. In its stead a cone-shaped drum is used that projects into the furnace, into the front side of which the tubes open. This drum is placed, so far as the products of combustion are concerned, entirely below the water level. The bottom line of the cone-shaped projection is straight, while at the top it curves over the double angle of the cone.

A straight steam collecting drum or tube is used instead of a steam drum, into which the steam flows through a hollow connection that is placed above the point where the most rapid generation takes place. At the back end there are the cab connections, on top are the safety valves, while the throttle is placed at the front.

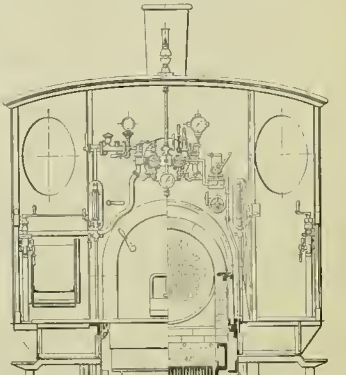
To this peculiar boiler the masonry firebox is added. This is closed at the top by a semicircular arch, which encloses the tubesheet drum already described. The arch rests upon brackets on either side and is independent of the remaining portion of the brickwork, which is locked to the sides of the firebox by special plates. The brickwork of the side and back walls of the firebox rest upon a cast iron frame that has an opening on the inside which is closed against the fire itself by iron plates. At the front end, two rows of bricks project out far enough to protect the bottom of the tubesheet drum from the direct action of the impinging flames.

The back wall rests upon a rectangular fire frame, and is closed by a sliding door whose vertical motion is controlled by a movable guide, both guide and slide being balanced by a counterweight. There is nothing novel in the arrangement of the grates, ashpan, dampers and the sheet-iron casing over the firebox.

The expansion of the boiler has no effect upon the firebox since the latter is not connected to the shell, but is fastened by itself upon its own frame. This arrangement has given no trouble at all.

The boiler was built at the machine shops of the Alpine Mountain Company (*Alpinen Montangesellschaft*) at Klagenfurt in 1893. The sheets are made of Martin basic steel from the Herkuost Works in Styria.

The two portions of the barrel are each riveted on the longitudinal seam, and the same is done with both portions of the steam drum; the shaped piece on the latter consisting of crucible cast steel. The mean inside diameter of the barrel is 3 feet 6.91 inches, with a thickness of .43 inch. The front tube sheet has a thickness of .79 inch and the back .43 inch: into these there are placed 99 rolled Mannesmann tubes, having an inside diameter of 1.61 inches, and an outside diameter of 1.81 inches, with an average length of 12 feet 1.27 inches between the tube sheets. These are expanded into



Locomotive With Mason-Work Firebox.—Fig. 2.

place in the usual manner with copper ferrules. The heating surface of the tubes thus amounts to 505.9 square feet and the total heating surface, including that portion of the tube-sheet drum that is subjected to the direct action of the flames, amounts to 518.6 square feet. The steam pressure is 12 atmospheres (180 pounds per square inch). The boiler was built into the locomotive No. 8822, that has a tender, under the direction of the designers. The principal dimensions as compared with those of an ordinary boiler are as follows:

Boiler.	New.	Ordinary.
Diameter of barrel.	3 feet 6.91 inches	3 feet 6.91 inches
Number of tubes.........	99	99
Diameter of tubes outside	1.81 inches	2.20 inches
" " " inside....	1.61 "	1.81 "
Length " "	12 feet 1.27 "	10 feet 9.92 "
Heating surface in tubes..	505.9 square feet	481.4 square feet
Total heating surface.........	518.6 " "	525.3 " "
Steam pressure...	180 pounds	180 pounds

After a number of tests both with and without loads, in all of which satisfactory results were obtained, the locomotive was placed in regular service in April, 1894, and ran along with six sister locomotives doing the same work,

* Translated from the *Organ für die Fortschritte des Eisenbahnwesens.*

remote from the designer so that he could not possibly have exerted any influence upon the results obtained in this service work.

After a service of seven months the locomotive was sent to the main shops at Knittelfeld, in order that a thorough inspection of the outside and inside of the boiler might be made for the purpose of ascertaining whether it had experienced any injury.

After the steam drum had been removed it was possible to enter the boiler and inspect it to the remotest corner without removing the tubes.

The sheets of the boiler, including the tubesheet drum, showed an even coating of scale over the whole surface to a thickness of about .04 inch, and this extended up to about the top of the average water line.

Since the coating of scale showed small cracks, and as there were none at the angles where the three stays connected, it is safe to conclude that the boiler was subjected to a slight change of form that was detrimental to it.

In the steam drum two flange bolts were broken; the reason being that the front end of the tube was bolted solidly to the throttle chamber. Later measurements showed that the drum had expanded by the heat .2 inches more than the corresponding portion of the boiler between the two points of attachment. After making an allowance for the necessary play, the locomotive was put back into service without any improvement being made in the boiler. In the brickwork of the firebox no improvement was necessary. A partial change was first made after it had been in service for 13 months. According to the results of the service as given in a report of a year's work in comparison with the sister locomotives we have the following:

Locomotive.	New.	Total of six ordinary.
Mileage.	25,405.5	149,535.1
Gross loads hauled	1,907,920 tons	11,235,655 tons
Consumption of coal per mile	31 6 pounds	35.76 pounds
Consumption of coal per 1,000 gross ton miles	678.0 "	786 00 "

This shows a saving n oal consumption in favor of experimental boiler, both in locomotive mileage and 1,000 ton miles, of about 11½ per cent.

This saving is not an inconsiderable matter in itself, but it should also be taken into consideration that this was obtained almost entirely with a low-priced brown coal whose theoretical calorific power only amounted to 12,220 heat units, which of itself was not at all favorable to a better showing.

OBSERVATIONS IN SERVICE.

The generation of steam from a perfectly cold boiler required, as was anticipated, from a half to three-quarters of an hour more time than with the ordinary boiler, while, on the other hand, after being housed it would retain its pressure for twelve hours, so that during this period the locomotive could be placed under a full head of steam in a few minutes.

The generation of steam is rapid and the water level can be kept at a high point while the boiler is being forced to the utmost. That this is the case is proven by the fact that investigation showed from the water line indicated on the inside of the boiler that it had been run with the glass entirely filled. In this connection there is the very remarkable fact to be borne in mind that there was never any water carried over into the cylinders

The arrangement of the steam drum must be considered as a fortunate one and one tending to collect steam that is dry. The application of this form of construction to the ordinary locomotive boiler instead of the uncomely and wide opening in the barrel for the dangerous vertical steam dome, is therefore certainly worthy of consideration.

The tubes are of the ordinary thickness, but an application of a thicker tube for staying purposes to the outer circle could be made to advantage. The bellied form of the tubesheet cannot be recommended for further application because the expanding of the tubes, especially those farthest from the center, is rendered difficult, and they are troublesome to keep tight except by constant calking.

On sultry summer days the radiation of heat from the firebox, especially from the back, was very oppressive. This difficulty was effectively met by the introduction of a brisk current of air in between the brickwork and the casing, but coupled with a loss of heat that was not an insignificant one.

The manner in which, upon a further application of this new form of boiler, the radiation is to be checked as much as possible, while, at the same time, the action of the fire is to be increased, will be developed in a future communication.

The many promising results that have been obtained with this new form of boiler on the experimental locomotive have induced the management of the Royal Austrian State Railway to build a similar boiler for a special locomotive and also a larger one for a locomotive of series No. 88.

The first, which will be a six-wheel coupled passenger engine, will soon be built and is already well on its way toward completion.

It is clearly to be seen that the steam-producing efficiency of the perfectly water-cooled firebox will be raised by the increased evaporation induced by the greater length of tubes obtained by lengthening the tubesheet drum. The considerably higher temperature of the products of combustion at the start, due to the conditions under which the fire burns in this box lined with firebrick, requires that the tubes should be slightly longer in order that the temperature of the gases entering the smokebox shall not be too high.

It has been thoroughly well established by experiment that in the Stephenson type of boiler there is no advantage in using tubes longer than 15 feet 9 inches, as far as steam production is concerned.

With this new form of boiler this length, which is the greatest that is efficient at present, may be increased, and with it comes the possibility that locomotives, like those having eight wheels coupled, for example, which up to the present time carry a useless weight of long tubes in their boilers, may be equipped with boilers that are considerably more efficient as steam producers. Furthermore, the new boiler is particularly well adapted for use on locomotives where bad feed water must be used, and where coal that contains a high percentage of sulphur must be burned. Finally, the new new boiler can well be used on construction locomotives, since these are, for the most part, in the hands of careless men.

Third Annual Convention of the Association of Railroad Air-Brake Men.

(*Concluded from Page* 76.)

In the discussion the drain cup received a good share of attention, and a number of members found the only satisfactory way to clean it was to take it down entirely and remove the dirt either with steam or a lye bath. Mr. Farmer spoke on the defect card and advocated its use, as where brakes could not be repaired at the station where the defects were first noted, either from lack of time or facilities, the card would be a notification to parties further along the line to make the needed repairs. Mr. Frazer said that on the Southern Pacific they used blanks for reporting not only brake defects but also hot boxes and drawbars pulled out. Mr Saunders said that on the Pennsylvania road blanks were used for reporting by inspectors and conductors. Both had to report and their reports were compared, and if they did not agree the man who failed to note a defect had to explain. Mr. Hawks, of the C. & A. Railway gave an interesting talk on maintenance, in the course of which he said that he had worked for the Alton over 40 years, and that he used to have a leather bag that contained all the tools he needed for repairs. Now, we must have test yards, racks, and many tools and appliances. Since he began his career in air-brake work, such advances have been made that now he has the sixth kind of triple, the sixth pump and the third kind of hose. He used cards and blank reports that are filled out and sent to him. The chairman, Mr. Brodnax, gave the results of some experiments in transmission of air through three-quarter-inch pipe half a mile long, with the idea of saving expense where the air had to be carried a long distance.

On the third day of the convention the report on "Main Reservoir and Connections" was read. The report is largely devoted to the location of the reservoir and to its volume. The location preferred is back of the cylinder saddle, between the frames The other possible locations are under the moving board and under the foot plate. It should never be located on the tender if it is possible to avoid it. A large main reservoir is advocated for the following reasons:

1st. Less delay in getting train charged for testing.

2d. Increased safety through ability to quickly release and recharge after any application, whether for stops, holding down grades, terminal tests, break in two, bursted hose or emergency application caused by engineer or trainmen.

3d. Increased life of air-hose and air-pump, combined with greater efficiency of the latter, and also decreased wear and better performance of engineer's brake valve.

4th. Less liability for triple valve to delay in releasing, and consequently wheels to slide.

5th. Less moisture in triple valves and consequent freezing up in winter.

For reasons given in the foregoing the committee recommend:

1st. That the capacity of main reservoirs be made greater than now generally employed. Sixteen thousand cubic inches or over for passengers, and 20,000 cubic inches or over for freight.

2d That where practicable, they be placed on engines and not on tender.

3d. That the air inlet and outlet be separated as far as possible, and the outlet be at the top of the reservoir.

4th. That but two connections to the main reservoir be made.

5th. That where possible, the pipes leading from pump to reservoir have a gradual incline for drainage toward the latter.

This report was not discussed at any great length and the one that followed, on "Train Signals," was not in type, but was read from the manuscript, and the members therefore were not able to discuss it.

The reports of committees having been disposed of, the remainder of the session was devoted to topical discussions and to election of officers, etc. Nashville was chosen as the place of meeting for 1897. The officers elected were as follows: President, S. D. Hutchins; First Vice-President, A. J. Cota; Second Vice-President, C. P. Cass; Third Vice-President, W. F. Brodnax; Secretary, P. M. Kilroy; Treasurer, Otto Best. Resolutions of thanks were passed to those who had extended courtesies to the association, including railroads that had furnished help to committees by giving them the facilities for carrying out experiments.

Experiments have, according to the *Improvement Bulletin*, recently been made by Mr. A. W. Haacke respecting the amount of heat lost by radiation through steam pipes. The tests were directed to determine the relative losses of heat from, first, bare pipes; second, pipes covered with 1 inch of insulating composition; and third, pipes covered with 1 inch of insulating composition and three layers of hair felt. The testing surfaces consisted of three cast-iron steam pipes of 5-inch external diameter, and 6 feet long, with black flanges on each end. The pipes were supplied by steam that had been dried and so placed as to be subject to radiation and conduction under precisely similar conditions, one being bare and two others covered, as before mentioned. The results of the experiment are quite interesting. With steam at a pressure of from 45 pounds to 60 pounds, out of a possible loss of 100 per cent., as much as 83 per cent. is saved by a 1-inch covering of composition. If over this covering 1 inch and 1½ inches of hair felt with canvas is added, the extra saving is only 8½ per cent. If 1 pound of coal is required to evaporate 8 pounds of water into steam at 60 pounds pressure, then every square foot of uncovered steam-pipe wastes 6½ hundredweight of coal per year. At a higher pressure of steam, and in cold weather, this loss is even greater.

The Most Advantageous Dimensions for Locomotive Exhaust Pipes and Smoke Stacks.*

BY INSPECTOR TROSKE.

(*Continued from page* 47.)

G. COMPARISON OF THE DIFFERENT FORMS OF STACKS.

If we bring together the three forms of stacks that have been considered, their own diameters and that of their nozzles being the same, what has been said will be made clear. A reference to Plate II. and the related Table VII brings this out.

The tables are full of information in many ways: First they show the slight rise in the course of the curves of cylindrical stacks over those of the conical, from which it again appears that those of the greatest flare have the highest curves. Up to a certain nozzle distance and with certain stack diameters the curves of the cylindrical stacks are the highest, while those with an inclination of one in six are the lowest, and those of the one in twelve stacks are between the two; then the first curve falls below that of the one in twelve stack, which also by a still further increase of the nozzle distance finally falls below that of the one in six stack. The larger the stack and the smaller the nozzle opening, just so much more striking do these differences become.

The tables belonging to Plate VII. give some information regarding this noteworthy phenomena They include the nozzle distances corresponding to three forms of stacks which have produced the highest vacuums with the five nozzles. These distances are here calculated from the bottom of the stack in order to keep the figures smaller. We next see that the maximum is reached considerably earlier with the cylindrical stack than it is with the conical, and in these latter again the less they flare open at the top. The two conical forms of stack can furthermore develop the same maximum if the nozzle distance is correspondingly adjusted In stacks with the smallest diameters of 14.76 inches for example a vacuum of 4 13 inches can be obtained with a nozzle diameter of 3.94 inches for the one in twelve stacks the nozzle distance from the bottom of the stack must be 1 foot 9.85 inches, for the one in six stacks this nozzle distance must be 2 feet 2.97 inches. In the same way with a cylindrical stack of 14 76 inches diameter we get a vacuum of only 0.2 inch less with a nozzle distance, measured from the bottom of the stack of 13.08 inches.

We see, further, from Table XIV, that the necessary nozzle distance for obtaining the highest vacuum with all forms of stacks increases the smaller the nozzle diameter.

TABLE VII.—SHORTENED STACKS.

A.—Cylindrical Stacks.

1.—Stack Diameter – 14.76 inches.

Length of stack.		Nozzle Diameters in Inches.				
		3.94	4.33	4.74	5.12	5.51
Full length	Beginning.	3.70	4.04	4.37	4.45	4.45
	Maximum.	3.94	4.26	4.57	4.65	4.57
Shortened 11.81 inches	Beginning.	3.11	3.43	3.74	3.86	3.92
	Maximum.	3.71	4.02	4.33	4.34	4.29
" 1 foot 8.87 inches	Beginning	2.52	2.81	3.11	3.27	3.41
	Maximum.	3.56	3.83	4.10	4.13	4.13
" 2 feet 3.56 inches	Beginning.	1.57	1.85	2.13	2.36	2.52
	Maximum.	3.35	3.59	3.57	3.94	3.83
Total fall in the vacuum for the beginnings		2.13	2.19	2.21	2.09	1.93

2.—Stack Diameter – 15.75 inches.

Length of stack.		Nozzle Diameters in Inches.				
		3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.43	3.76	4.09	4.23	4.29
	Maximum	3.74	4.06	4.37	4.51	4.45
Shortened 11.81 inches	Beginning.	2.82	3.11	3.43	3.62	3.71
	Maximum	3.58	3.89	4.18	4.27	4.21
" 1 foot 8.87 inches	Beginning	2.20	2.48	2.78	3.02	3.19
	Maximum.	3.41	3.74	4.03	4.13	4.02
" 2 feet 3.56 inches	Beginning	1.34	1.61	1.89	2.11	2.32
	Maximum.	3.25	3.54	3.84	3.94	3.83
Total fall in the vacuum for the beginnings		2.00	2.15	2.20	2.12	1.87

NOTE.—The figures give the vacuum in inches of water at the beginning with a nozzle position of 1 ft. 6.9 in., and the maximum values obtained, whose corresponding nozzle location varies with the diameter of the stack.

3.—Stack Diameter — 16.73 inches.

Length of Stack.		Nozzle diameters in inches.				
		3.94	4.33	4.74	5.12	5.51
Full length	Beginning.	3.41	3.45	3.78	3.94	4.04
	Maximum	3.50	3.84	4.13	4.29	4.33
Shortened 11.81 inches	Beginning.	2.48	2.80	3.11	3.30	3.43
	Maximum	3.39	3.70	3.90	4.09	4.13
" 1 foot 8.87 inches	Beginning.	1.89	2.17	2.46	2.68	2.83
	Maximum.	3.27	3.52	3.94	3.96	3.91
" 2 feet 3.68 inches	Beginning	1.06	1.34	1.61	1.85	2.05
	Maximum.	3.03	3.37	3.64	3.80	3.90
Total fall in the vacuum for the beginnings.		2.05	2.11	2.17	2.09	1.99

4.—Stack Diameter 17.72 inches.

Length of Stack.		Nozzle diameters in inches.				
		3.94	4.33	4.74	5.12	5.51
Full length	Beginning.	2.80	3.11	3.45	3.62	3.74
	Maximum.	3.25	3.56	3.91	4.06	4.09
Shortened 11.8 inches	Beginning.	2.17	2.46	2.78	2.97	3.11
	Maximum.	3.17	3.50	3.82	4.06	4.06
" 1 foot 8 inches	Beginning.	1.57	1.83	2.11	2.32	2.48
	Maximum.	3.05	3.39	3.72	3.90	3.98
" 2 feet 3.56 inches	Beginning.	0.85	1.04	1.26	1.46	1.63
	Maximum.	2.83	3.17	3.50	3.68	3.82
Total fall in the vacuum for the beginnings		1.95	2.07	2.19	2.16	2.11

* Paper read before the German Society of Mechanical Engineers, and published in *Glasers Annalen für Gewerbe und Bauwesen.*

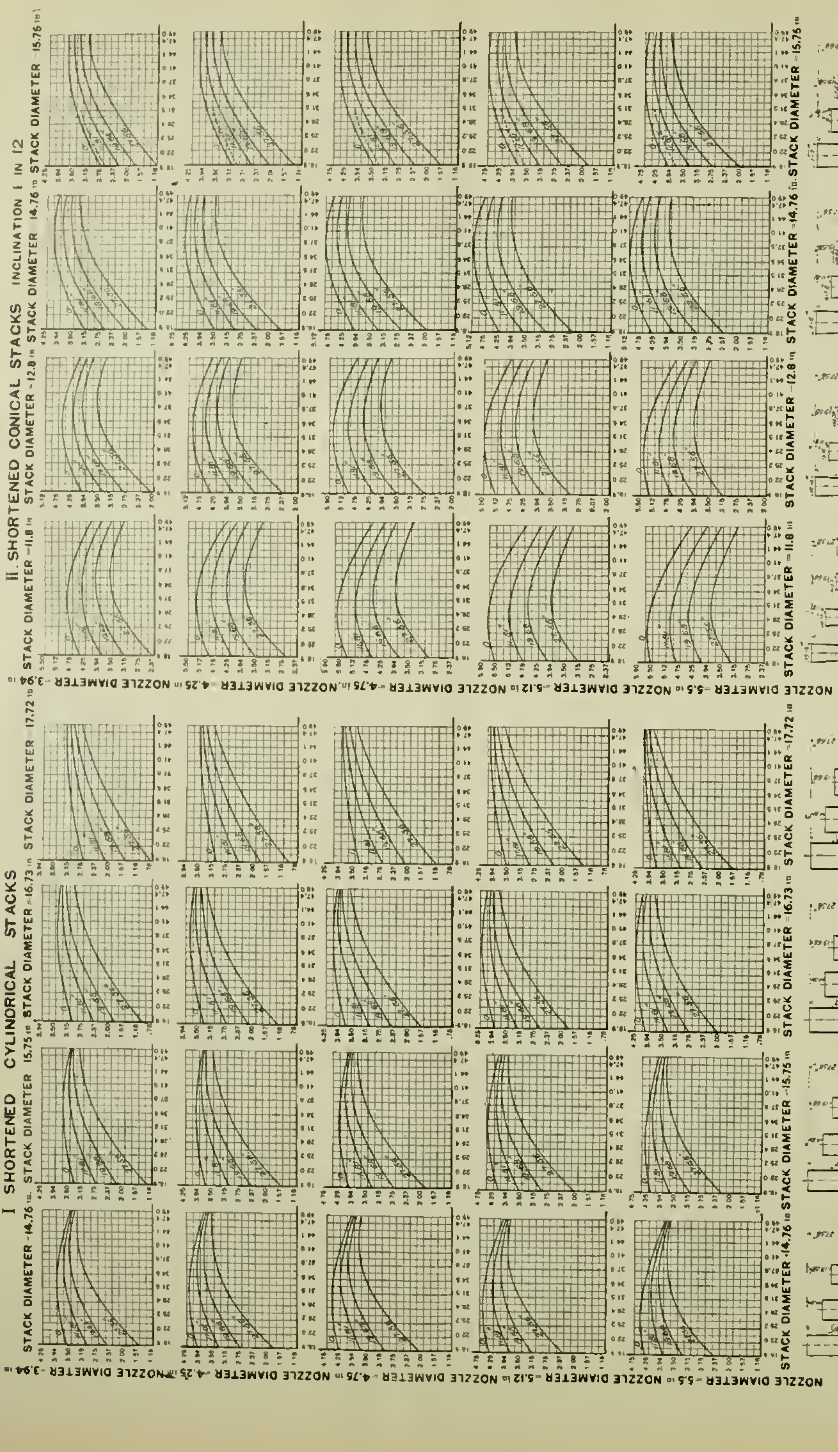


PLATE III.—DETAIL DIAGRAMS OF THE HANOVER SMOKESTACK AND EXHAUST NOZZLE EXPERIMENTS.

NOTE.—1. All of the observations were taken with the same steam pressure (3.94 in. of mercury) and with the same openings for the admission of air.
2. The four curves shown on each diagram are taken from the same points with the full-length stack and then shortened three times. The amount of the shortening (11.81 in., 19.68 in. and 27.56 in.) is marked above each curve.

TABLE VIII. B.—CONICAL STACKS WITH AN INCLINATION OF 1 IN 12.

1.—Stack Diameter = 11.81 inches.

Length of stack.		Nozzle diameters in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	4.49	4.92	5.35	5.53	5.55
	Maximum	4.90	5.29	5.65	5.75	5.67
Shortened 11.81 inches	Beginning	3.84	4.23	4.63	4.78	4.82
	Maximum	4.49	4.86	5.12	5.15	5.04
" 1 foot 8.87 inches	Beginning	3.23	3.56	3.99	4.06	4.11
	Maximum	4.08	4.41	4.63	4.63	4.49
" 2 feet 3.56 inches	Beginning	2.40	2.72	3.03	3.19	3.29
	Maximum	3.64	3.00	4.00	3.96	3.86
Total fall in the vacuum for the beginnings.		2.09	2.20	2.32	2.34	2.26

2.—Stack diameter = 12.8 inches.

Length of stack.		Nozzle diameters in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	4.06	4.49	4.06	5.15	5.24
	Maximum	4.69	5.03	5.41	5.49	5.43
Shortened 11.81 inches	Beginning	3.46	3.84	4.25	4.49	4.61
	Maximum	4.32	4.65	4.96	5.07	5.02
" 1 foot 8.87 inches	Beginning	2.85	3.10	3.58	3.82	3.98
	Maximum	4.02	4.31	4.53	4.63	4.61
" 2 feet 3.56 inches	Beginning	2.07	2.40	2.78	3.03	3.19
	Maximum	3.60	3.89	4.08	4.13	4.01
Total fall in the vacuum for the beginnings.		2.01	2.08	2.18	2.12	2.05

3.—Stack diameter = 14.76 inches.

Length of stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.25	3.62	4.06	4.33	4.49
	Maximum	4.13	4.49	4.91	5.11	5.12
Shortened 11.81 inches	Beginning	2.60	3.02	3.39	3.66	3.86
	Maximum	3.88	4.21	4.59	4.75	4.78
" 1 foot 8.87 inches	Beginning	2.09	2.40	2.74	3.00	3.23
	Maximum	3.62	3.98	4.30	4.41	4.41
" 2 feet 3.56 inches	Beginning	1.42	1.69	1.99	2.22	2.14
	Maximum	3.39	3.64	3.90	4.04	3.98
Total fall in the vacuum for the beginnings		1.83	1.93	2.07	2.11	2.06

4.—Stack diameter = 15.75 inches.

Length of stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	2.82	3.17	3.58	3.86	4.06
	Maximum	3.78	4.13	4.55	4.74	4.74
Shortened 11.81 inches	Beginning	2.30	2.64	3.00	3.25	3.45
	Maximum	3.62	3.96	4.35	4.49	4.51
" 1 foot 8.87 inches	Beginning	1.81	2.11	2.40	2.64	2.85
	Maximum	3.46	3.78	4.13	4.27	4.30
" 2 feet 3.56 inches	Beginning	1.18	1.42	1.65	1.87	2.08
	Maximum	3.19	3.62	3.84	3.98	3.98
Total fall in the vacuum for the beginnings.		1.64	1.75	1.93	1.99	1.98

TABLE IX. C.—CONICAL STACKS WITH AN INCLINATION OF 1 IN 6.

1.—Stack Diameter = 11.81 inches.

Length of Stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.84	4.31	4.88	5.15	5.22
	Maximum	4.98	5.35	5.73	5.87	5.80
Shortened 11.81 inches	Beginning	3.30	3.74	4.23	4.49	4.65
	Maximum	4.57	4.25	5.26	5.34	5.28
" 1 foot 8.87 inches	Beginning	2.80	3.19	3.62	3.86	4.02
	Maximum	4.21	4.55	4.80	4.86	4.78
" 2 feet 3.56 inches	Beginning	2.17	2.50	2.87	3.08	3.23
	Maximum	3.76	4.02	4.15	4.17	4.09
Total fall in the vacuum for the beginnings.		1.67	1.81	2.01	2.07	2.09

2.—Stack Diameter = 12.8 inches.

Length of Stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	3.43	3.86	4.37	4.69	4.92
	Maximum	4.65	5.06	5.41	5.69	5.56
Shortened 11.81 inches	Beginning	2.89	3.29	3.76	4.06	4.27
	Maximum	4.25	4.74	5.03	5.19	5.15
" 1 foot 8.87 inches	Beginning	2.40	2.76	3.19	3.40	3.66
	Maximum	4.06	4.42	4.71	4.56	4.79
" 2 feet 3.56 inches	Beginning	1.79	2.13	2.52	2.76	2.92
	Maximum	3.87	4.00	4.26	4.33	4.25
Total fall in the vacuum for the beginnings.		1.64	1.73	1.85	1.93	1.97

3.—Stack Diameter = 14.76 inches.

Length of stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	2.56	2.95	3.37	3.70	3.96
	Maximum	4.12	4.53	4.92	5.10	5.11
Shortened 11.81 inches	Beginning	2.13	2.48	2.83	3.13	3.39
	Maximum	3.88	4.27	4.61	4.70	4.79
" 1 foot 8.87 inches	Beginning	1.69	2.00	2.34	2.66	2.87
	Maximum	3.04	4.03	4.23	4.45	4.47
" 2 feet 3.56 inches	Beginning	1.16	1.44	1.73	1.97	2.20
	Maximum	3.35	3.68	3.06	4.06	4.06
Total fall in the vacuum for the beginnings.		1.40	1.51	1.64	1.73	1.76

4.—Stack Diameter = 15.75 inches.

Length of Stack.		Nozzle diameter in inches. 3.94	4.33	4.74	5.12	5.51
Full length	Beginning	2.18	2.48	2.85	3.17	3.41
	Maximum	3.78	4.15	4.57	4.74	4.80
Shortened 11.81 inches	Beginning	1.77	2.07	2.40	2.66	2.89
	Maximum	3.58	3.96	4.25	4.49	4.57
" 1 foot 8.87 inches	Beginning	1.40	1.67	1.97	2.20	2.42
	Maximum	3.43	3.78	4.13	4.29	4.33
" 2 feet 3.56 inches	Beginning	.96	1.18	1.44	1.65	1.87
	Maximum	3.19	3.54	3.86	4.06	4.06
Total fall in the vacuum for the beginnings.		1.19	1.30	1.41	1.62	1.54

the steam pressure remaining the same. Thus, for example, suppose the nozzle diameter drops from 5.51 inches to 3.94 inches the amount of steam delivered falls to about one-half and the nozzle distance, measured from the bottom of the stack, with a diameter of 14.76 inches, increases as follows:

Cylindrical stack	from 10.04 inches	to 13.98 inches.
One in twelve "	" 17.92 "	" 21.85 "
" " six "	" 23.43 "	" 26.97 "

Thus in all three cases the variation is about the same, or 3.94 inches. This increase of the nozzle position shows that, according to Section VIII., the stream of steam issuing from a small nozzle under otherwise equal conditions forms a smaller cone than that issuing from a larger one, so that with the same location of the nozzle the full section of the stack is filled later, which means that it is filled at a greater distance from the nozzle opening. Finally, Table VII. also shows that, with the nozzle in the same position and within the limits recommended above for practical work, the cylindrical stack produces the highest vacuum, its diameter being equal to that of the waist of the others, yet with the sharpest taper, as well as with the least, the vacuum produced can be equalized, provided that the nozzle diameter is properly proportioned to the stack diameter.

TABLE X.

Exhaust Nozzle. Diameter.	Reduction of vacuum in inches as the result of a further shortening of the cylindrical and conical stacks by 15.75 inches, with a nozzle location of 18.9 inches below the bottom of the same. Shortened 11.81 in.			Shortened 19.68 in.			Shortened 27.56 in.		
Inches.	Cyl.	1/12	1/6	Cyl.	1/12	1/6	Cyl.	1/12	1/6
3.94	0.61	0.51	0.37	1.22	1.00	0.75	2.09	1.63	1.18
4.33	0.65	0.53	0.41	1.28	1.06	0.81	2.16	1.75	1.30
4.74	0.67	0.59	0.45	1.32	1.18	0.89	2.20	1.93	1.42
5.12	0.61	0.61	0.49	1.22	1.22	0.96	2.13	1.98	1.52
5.51	0.55	0.61	0.51	1.10	1.20	0.98	1.97	1.97	1.54

TABLE XI.

Total Shortening.	Cylindrical.	Conical, 1/12.	Conical, 1/6.
11.81 inches.	0.0523 inch.	0.0183 inch.	0.0378 inch.
19.68 "	0.0624 "	0.0585 "	0.0416 "
27.56 "	0.0765 "	0.0672 "	0.0517 "

IV.—EXPERIMENTS IN THE SHORTENED STACKS.

The experiments with the 15 stacks heretofore discussed were now extended, so that the whole series was repeated with stacks shortened an equal amount, as follows:

1. By a shortening of 11.42 inches.
2. By additional shortening of 7.87 inches.
3. " " " " 7.87 "

} Total, 27.16 inches.

All of the shortened stacks were tested with the e nozzles under the same conditions as before. The results obtained for each of the three forms of stack are given in Table X. and XI., and for the two nozzle positions in the accompanying Tables VII. to IX.

As a first result of the shortening of the stack there was a very noticeable diminution of the vacuum produced. This reduction was not in an exact ratio to the amount of shortening, but was somewhat greater, as will be seen from table X.

For each inch of shortening in the above table the vacuum falls about as given in table XI.

We see that this fall in the vacuum is considerably more for the cylindrical stacks than it is for the conical ones; and for the latter the loss is the greater as the opening at the top is narrower.

Thus we find a skillfully demonstrated refutation of the proposition erroneously stated by Zenner, that the height of the stack has a very subordinate influence upon the action of the blast nozzle.

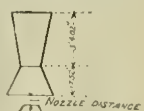
This is shown still more clearly in Fig. 36. It gives the fall in the vacuum, with cylindrical stacks having a diameter of 17.72 inches and an original length of 7 feet 4.6 inches, or five times the diameter, that are gradually shortened to nothing. The three curves show the vacuums produced with nozzle openings of 3.94 inches, 4.74 inches and 5.51 inches. Their co-ordinates were obtained on the experimental apparatus under the same conditions as the rest of the data.

TABLE XIV.—COMPARISON OF THE HIGHEST INDICATED VACUUMS AND THE CORRESPONDING DISTANCES OF THE EXHAUST NOZZLES FROM THE LOWER ENDS OF STACKS OF EQUAL DIAMETERS.

(a) Full Length Stacks.

Stacks. Diam.	Shape.	Exhaust Nozzle Diameters. 3.94 in. Vacuum.	3.94 in. Nozzle Location.	4.33 in. Vacuum.	4.33 in. Nozzle Location.	4.74 in. Vacuum.	4.74 in. Nozzle Location.	5.12 in. Vacuum.	5.12 in. Nozzle Location.	5.51 in. Vacuum.	5.51 in. Nozzle Location.
Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
13.78	Cylindrical	4.04	8.86	4.29	8.47	4.58	6.89	4.61	6.32	4.53	1.57
	Conical 1/12	4.37	18.70	4.79	18.31	5.14	17.13	5.28	15.55	5.28	13.00
	" 1/6	4.33	23.43	4.77	23.04	5.15	21.85	5.22	20.07	5.37	10.29
14.76	Cylindrical	3.94	13.98	4.26	13.78	4.57	13.00	4.65	12.21	4.57	10.04
	Conical 1/12	4.13	21.65	4.49	21.65	4.94	20.87	5.11	20.08	5.12	17.92
	" 1/6	4.12	26.97	4.53	26.38	4.92	25.79	5.10	25.00	5.14	23.43
15.75	Cylindrical	3.74	18.70	4.06	18.70	4.37	17.13	4.51	16.34	4.45	12.40
	Conical 1/12	3.78	25.00	4.13	25.10	4.55	24.21	4.74	19.19	4.71	21.06
	" 1/6	3.78	30.51	4.15	30.51	4.57	29.73	4.74	28.94	4.80	26.58

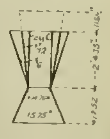
1. The vacuums given are the maxima produced with a steam pressure of 100 mm. (3.94 in.) of mercury. 2. The corresponding nozzle locations here indicate the distances from the top of the nozzle to the bottom of the stack, at which the highest vacuums were obtained. 3. In order to get the distance from the nozzle to the narrowest portion (the waist) of the stack we must add 17.52 in. to the amount given in the tables.



(b) Stacks Shortened 11.81 Inches (300 mm.)

Stacks. Diam.	Shape.	Exhaust Nozzle Diameters. 3.94 in. Vacuum.	3.94 in. Nozzle Location.	4.33 in. Vacuum.	4.33 in. Nozzle Location.	4.74 in. Vacuum.	4.74 in. Nozzle Location.	5.12 in. Vacuum.	5.12 in. Nozzle Location.	5.51 in. Vacuum.	5.51 in. Nozzle Location.
Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
14.76	Cylindrical	3.74	19.10	4.02	18.70	4.33	17.72	4.31	15.65	4.29	13.98
	Conical 1/12	3.88	24.02	4.29	23.62	4.59	22.61	4.75	21.26	4.78	20.28
	" 1/6	3.68	28.35	4.27	28.35	4.61	27.30	4.76	26.38	4.79	25.40
15.75	Cylindrical	3.58	23.43	3.89	21.85	4.18	21.26	4.27	20.28	4.21	16.54
	Conical 1/12	3.02	29.73	3.96	28.15	4.35	27.56	4.49	26.58	4.51	24.41
	" 1/6	3.68	31.30	3.96	31.30	4.35	30.71	4.49	30.32	4.57	28.15

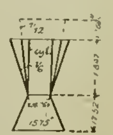
The stack of 13.78 in. diameter was not shortened.



(c) Stacks Shortened 19.66 in. (500 mm.)

Stacks. Diam.	Shape.	Exhaust Nozzle Diameters. 3.94 in. Vacuum.	3.94 in. Nozzle Location.	4.33 in. Vacuum.	4.33 in. Nozzle Location.	4.74 in. Vacuum.	4.74 in. Nozzle Location.	5.12 in. Vacuum.	5.12 in. Nozzle Location.	5.51 in. Vacuum.	5.51 in. Nozzle Location.
Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
14.76	Cylindrical	3.66	22.44	3.83	22.25	4.11	20.87	4.13	20.28	4.08	18.31
	Conical 1/12	3.62	26.38	3.98	26.18	4.30	24.80	4.41	24.21	4.41	22.64
	" 1/6	3.61	30.32	4.01	30.32	4.33	28.74	4.45	28.15	4.47	26.58
15.75	Cylindrical	3.45	31.30	3.74	28.15	4.04	26.58	4.17	23.43	4.07	20.98
	Conical 1/12	3.46	31.30	3.78	31.80	4.13	30.32	4.27	29.73	4.30	28.15
	" 1/6	3.43	31.30	3.78	31.30	4.13	31.30	4.29	31.30	4.33	29.73

The stack of 13.78 in. diameter was not shortened.



(d) Stacks Shortened 27.56 in. (700 mm.)

Stacks. Diam.	Shape.	Exhaust Nozzle Diameters. 3.94 in. Vacuum.	3.94 in. Nozzle Location.	4.03 in. Vacuum.	4.03 in. Nozzle Location.	4.74 in. Vacuum.	4.74 in. Nozzle Location.	5.12 in. Vacuum.	5.12 in. Nozzle Location.	5.51 in. Vacuum.	5.51 in. Nozzle Location.
Inches.		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
14.76.	Cylindrical	3.35	29.73	3.59	28.15	3.81	25.79	3.94	25.00	3.83	22.84
	Conical 1/12	3.39	31.30	3.64	30.51	3.90	28.94	4.04	26.00	3.98	25.79
	" 1/6	3.35	31.30	3.68	31.30	3.98	29.73	4.06	29.73	4.06	28.35
15.75.	Cylindrical	3.25	31.30	3.64	31.30	3.84	31.30	3.91	29.73	3.81	26.58
	Conical 1/12	3.19	31.30	3.52	31.30	3.84	31.30	3.98	31.30	3.98	31.30
	" 1/6	3.19	31.30	3.54	31.30	3.86	31.30	4.06	31.30	4.06	31.30

The stack of 13.78 in. diameter was not shortened.

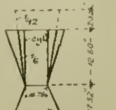
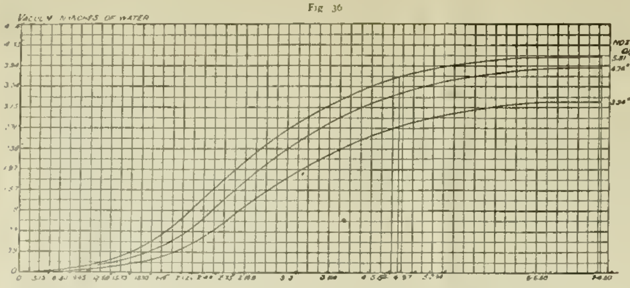


Fig. 36



From this diagram we see that the highest vacuum was obtained with a stack length of 6 feet 7.53 inches, which is about 1.7 times the diameter, that it falls rapidly with the decreasing length until at 2 feet 7.5 inches it begins to drop more slowly, and gradually dies away at the zero point. We see, therefore, that with stacks having a length of from 2 feet 0 inches to 2 feet 11 inches, measured from the nozzle opening, or a length equal to about twice the diameter, air comes in from above and that this influx increases as the length decreases. The current of steam with its surrounding mantel of air no longer fills the whole sectional area of the stack, and consequently the external air can be drawn into the apparatus. The same phenomenon was also observed by Zeuner and Prismann.

From tables X. and XI. it also follows that the same vacuum can be obtained with different lengths of stacks having the same diameters if the position of the nozzle is properly adjusted.

The shorter the actual stack, by just so much must the position of the nozzle be lowered if the vacuum is to remain the same, and the longer the stack, the higher must the nozzle be placed.

The great influence that a lowering of the nozzle has upon the vacuum, especially when the stack has been shortened, is clearly shown in Table XII.

TABLE XII.

Increase of the vacuum for a stack 15.75 inches in diameter, that had been shortened 19.68 inches as above, when the position of the exhaust nozzle is dropped from 19.68 inches to 39.37 inches below the bottom, the total height thus remaining unchanged.

Diameter of exhaust nozzle inches	Cylindrical	Conical, $\frac{1}{25}$ inclination.	Conical, $\frac{1}{4}$ inclination.
3.91	From 2.28 to 3.37 in. = 47.1 per cent.	From 1.89 to 2.05 in. = 75.0 per cent.	From 1.48 to 3.16 in. = 116 per cent.
4.33	From 2.56 to 3.7 in. = 41.6 per cent.	From 2.19 to 3.62 in. = 65.7 per cent.	From 1.77 to 3.50 in. = 97.7 per cent.
4.74	From 2.83 to 4 in. = 41.0 per cent.	From 2.48 to 4.03 in. = 62.3 per cent.	From 2.05 to 3.88 in. = 88.4 per cent.
5.12	From 3.08 to 4.13 in. = 34.0 per cent.	From 2.72 to 4.17 in. = 53.6 per cent.	From 2.36 to 4.07 in. = 76.9 per cent.
5.51	From 3.25 to 4.02 in. = 23.6 per cent.	From 2.93 to 4.25 in. = 45.6 per cent.	From 2.52 to 4.21 in. = 67.1 per cent.

It is worthy of noting just here that where the foregoing position of the exhaust nozzle was 19.68 inches (500 millimeters) from the bottom of the stack, the vacuum belonging to the cylindrical stacks was almost exactly .8 inch higher for each of the five diameters of nozzles than that belonging to the conical stacks, with an inclination of $\frac{1}{4}$, and about .35 in. greater than those with an inclination of $\frac{1}{25}$; while when the nozzle was dropped to 39.37 inches the vacuums were practically the same. The same difference of from .35 inch to .8 in. can also be observed in the diagrams of the curves accompanying the text. It should be thoroughly understood right here that all the text relating to the six plates, inclusive of the technical portions, was first compiled after the latter had been entirely completed.

The correspondence of the vacuum with the nozzle at a distance of 39.37 inches which has been mentioned, is probably due to the fact that the stack will be filled with the current of steam in its smallest cross-section when the nozzle stands at 27.5 inches so that at 39.37 inches it (1,000 mm.), taking the loss of velocity into consideration, the vacuums will be the same for all three forms.

The question as to how much the nozzle distance must be increased for a given shortening of the stack, if the same vacuum is to be maintained as belonging to the unshortened stack is answered in Table XIII.

TABLE XIII.

Shape of Stack	The increase in the nozzle distance required for maintaining a constant vacuum, when the stack is shortened by 11.81 in.	19.68 in.	27.56 in.
Cylindrical	12.60 in.	18.90 in. to 20 in.	27.5 to 28 in. (with diameters of 17.75 in. only or more.
Conical $\frac{1}{25}$ incl.	7.87 in.	13.00 in.	18.9 in.
Conical $\frac{1}{4}$ incl.	3.94 in. to 4.74 in.	7.87 in.	12.6 in.

From this it will be seen that the increase of distance is less than the amount of the shortening with the conical stacks, while with the cylindrical stacks it remains about the same. It appears, too, that the total working height of the former from the nozzle to the top of the stack is not the same, but decreases as the stack is shortened by the corresponding failure of the nozzle distance to keep pace with the same, and this also holds true the wider the opening at the top. For example, suppose a conical stack with an inclination of $\frac{1}{4}$ to be shortened at the top 3.94 inches (100 mm.), the corresponding increase of nozzle distance would be about 1.6 inches, while for a stack having an inclination of $\frac{1}{25}$ it would be about 2.6 inches.

It is an interesting conclusion to be drawn from tables X. and XI. that, as shown by table XIV, which follows, it is possible to maintain the same maximum vacuum with different shapes and lengths of stacks by merely changing the position of the exhaust nozzle.

(To be Continued.)

Trade Catalogues

[In 1894 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

STANDARDS.

For postal-card circulars	$3\frac{1}{2}$ inches by $6\frac{1}{4}$ inches.
Pamphlets and trade catalogues	$3\frac{1}{2}$ inches by 6 inches. 6 inches by 9 inches. 9 inches by 12 inches.
Specifications and letter-paper	$8\frac{1}{2}$ inches by $10\frac{3}{4}$ inches.

THE "CLEVAUC" STEAM SPECIALTIES. *The Clarence E. Van Auken Co., 166-174 South Clinton street, Chicago, Ill.* 40 pages, 6 inches by 9 inches.

The specialties illustrated in this catalogue bear the stamp of originality combined with neatness and simplicity of design. The company say their line of steam specialties is larger and more complete than that of any other concern, and the catalogue certainly shows an extensive line of these goods. The first illustration is of a safety water column, the alarm valve of which is worked by buckets instead of floats. These are always full of water and are in no danger of collapse. Then follow regulators for high and low pressures, noiseless back-pressure valves for either horizontal or vertical pipes, pump governors for elevator and water works pumps, house pump governors, air compressor governors, automatic receiving tanks and governors for modern heating systems, damper regulators, temperature regulators, syphon automatic air valves, high and low pressure steam traps and other devices. The most approved methods of applying some of these mechanisms are illustrated by diagrams. The steam traps mentioned are constructed on a new principle, giving continuous discharge, and operating without pressure in the trap. The cover can be removed while it is in operation without shutting off the pressure. Some of these traps are operating in plants carrying 225 pounds pressure.

The catalogue is embellished by numerous full-page illustrations of notable buildings in which the Clevauc specialties are in use.

ILLUSTRATIONS OF THE SPECIAL LINE OF MACHINE TOOLS, *For Working Iron and Steel Plates, Bars and Structural Shapes.* Built by Hilles & Jones Company, Wilmington, Del., 82 pages, $8\frac{3}{4}$ by 12 inches.

This publication was evidently intended to be of the standard size of 9 by 12, but the binder has trimmed it a quarter of an inch too small in one direction. It consists as its title implies of illustrations only, without any descriptive matter relating to the machines represented. The engravings are mostly of the half tone variety. These represent a number of heavy shearing and punching machines, plate planers, beam coping and straightening machines, bending rolls and a milling machine. The illustrations in the latter part are very good wood engravings, and are generally very fair, but some of them would have been improved if the machines had been a little more carefully painted before they were photographed.

The illustration on page 10 is an example, some of the cast iron of which looks as though it was suffering from a cutaneous eruption. In view of the importance of photography to the mercantile department of mechanical engineering, it may be expected that in the near future, a photographing room, provided with the best light and other accessories for producing good pictures will be required in every first class establishment.

THE STANDARD WATER TUBE SAFETY BOILER. *The Standard Boiler Company, Marquette Building, Chicago, Ill.* 16 pages, $6\frac{3}{4}$ by $9\frac{1}{4}$ inches. (Not standard size.)

This pamphlet gives first an isometrical view of one of their boilers, with part of the brick work removed, and then a longitudinal section in outline. After this what is called a "description" of the boiler is given, but which is in reality only assertions of its advantages. The criticism which should be made here is that if the publishers had given a fuller and clearer description of their boiler, so that the reader could get a clear idea of its construction that then the vaunting of its merits, would produce a much greater impression than it now does. It should be remembered in writing such literature, that nine readers out of ten, are absolutely ignorant of the construction of the objects described. The first thing to do then—and generally the first thing the reader wants to know—is how is it made? and how does it work? After he understands this, then it is in order to boast of its merits. To illustrate what we mean—something is said about the tubes of the boiler being expanded in the wrought steel headers, but there is no description of these "headers," and although they may, and probably do, have all the merits claimed for them, yet a person about to buy a boiler before doing so would certainly want to know more about them than the makers have told us in the publication which is here reviewed. The rule to be observed is to describe first as fully and as clearly as possible, and then boast, brag and hustle afterwards.

Perspective views of a 4,000 horse-power installment of these boilers, for the North Chicago Railway; two others, showing "headers" and drums, ready for shipment; an outside view of a power station; other engravings, showing a boiler front, the inside of the works and a sectional view of the building of the Second Avenue Traction Company of Pittsburgh, Pa., are given. Lists of users of these boilers, and testimonials of their merits are also added.

"THE NORWALK" AIR AND GAS COMPRESSOR. *Manufactured by the Norwalk Iron Works Company, South Norwalk, Conn.*, 106 pages, 7 by $9\frac{3}{8}$ inches. (Not standard size.)

The extended use of compressed air for so many purposes gives especial interest at the present time to a catalogue devoted to machinery of this class. Interest, too, is greatly increased when the subject is treated as well as it is in the publication before us, and which is evidence of the fact to which we have often called attention, that the best literature relating to many subjects is now found in catalogues of this kind.

The extent and the variety of uses to which compressed air is now used is indicated by the following observations in the introduction to this book. It is there said: "Old uses (of compressed air) have been extended; abandoned plans have been revived and economically carried out; many new processes, using compressors, have been developed, and experimenters are still busily engaged in further extending the uses of compressed air. We have been called upon to build machines to develop heat, and to produce cold; to move air with a force hardly greater than the breath of a child, and to blow a shot from a cannon; to lift tons of iron, and to clean a watch; to steer a vessel and to launch the torpedo to destroy her."

The book begins with a general introduction of the subject, which is followed by illustrations of eight different patterns of compressors, which have been successively developed. A brief description of their points of difference is given, but would have been more satisfactory if it had been made fuller and had been illustrated with sectional views. Twelve pages are then devoted to a description of the principles and the construction of the "Norwalk Compressors," which is illustrated by another drawing of one of them with some of the internal parts represented by dotted lines. A chapter on the capacity of these machines is followed by very good engravings and descriptions of the different patterns and types which are made. There are in all 26 different air compressors and six gas compressors illustrated. Besides these there are three special compressors shown which are intended for charging pneumatic locomotives, several forms of the latter being also shown.

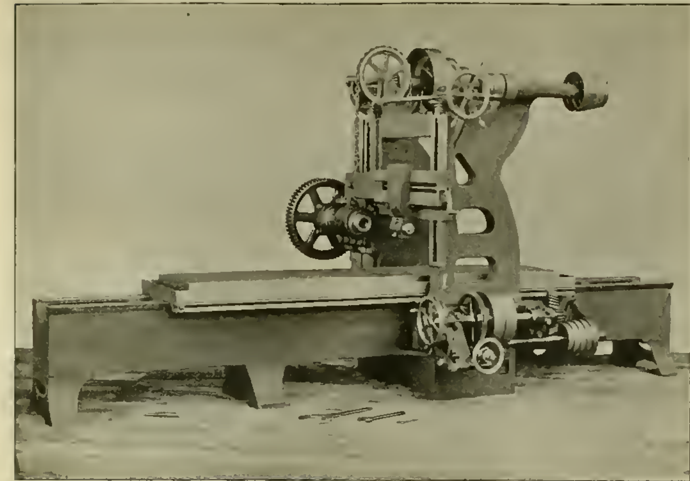
A view of Captain Glassford's army balloon, which was inflated with hydrogen gas that was compressed in steel tanks by one of these machines, is given, and also one of the dynamite cruiser *Vesuvius* whose guns are operated by air compressed by a Norwalk machine to a pressure of 5,000 pounds per square inch. There is also an engraving of a compressor for the monitor *Terror*, on which compressed air is used for many purposes as a substitute for steam in places remote from the boilers, or when exhaust steam would be a menace to health and safety.

A disappearing gun and carriage erected at the entrance of New York harbor is also shown, which is loaded, moved into position and aimed by compressed air. At the end of the book a number of special forms of compressors—some with oscillating cylinders and others placed vertically—are shown. The catalogue ends with an essay on the efficiency of compressed air engines, another on the requirements of rock drills and a very good index.

The book is well printed on good paper and the engravings are excellent. The only criticism for which there seems to be any ground is that it is not a standard size and the cover has a sort of gay and frisky style hardly consistent with the sober character of the subject and the contents of the book.

RULES. Darling, Brown & Sharp, Providence, R. I. 12 pages. 3 by $5\frac{1}{4}$ inches. (Not standard size.)

The purpose of this little catalogue is to describe the well-known steel rules made by this company. It is also announced that they now make "tempered rules" as accurately graduated as the Standard, or soft, rules are. The catalogue contains engravings and tables of sizes, etc., of this company's products.



Milling Machine for Horizontal and Vertical Milling.

Milling Machine for Horizontal and Vertical Milling.

Most of the milling operations in which our readers are interested are heavy enough to require a machine of more than ordinary strength, and it may be truly said that if milling tools are to supplant the planer to any great extent they must be of a very substantial character. The machine we illustrate has been designed by the firm of Bement, Miles & Company, Philadelphia, Pa., with a full knowledge of this fact, and is capable of doing the heaviest class of milling. It has a substantial bed and housings. The spindle has large bearings, adjustable for wear, and is geared eighteen times from a 24-inch cone driven by a 6-inch belt. The table is from 20 inches to 28 inches wide on the clamping surface, and is gibbed down to the bed. It traverses by hand or power, by means of a spiral pinion, which gives a perfectly smooth motion. It is also provided with a quick movement in either direction by friction pulleys. Surrounding the table is a tray which leads the lubricating fluid into a tank behind the machine. The distance between uprights is from 26 inches to 36 inches. The machine can be built so that the cross slide, which is counterweighed, will raise to any desired height above the table. There is an adjustable support for the outer end of the cutter bar, and the spindle has horizontal adjustment to suit various lengths of cutters up to the full width of the table.

The feed can be varied from one to nine inches per minute and is provided with an automatic stop motion for throwing out at any desired point. All the gearing is cut from the solid, all shafts are steel running in bronze bushings, and the workmanship on the machine is thoroughly first-class. All parts are made strong, heavy and of the best material. The various handles controlling the actions of the machine are so located that they can all be operated from the most convenient position for the operator. Two countershafts, all necessary wrenches, a pump and two tanks for circulating lubricant to the cutters, are provided with the machine.

The machine can be built of any required length. Also an additional head for vertical milling cutters can be applied to the cross slide without destroying the arrangement of the heads for horizontal milling. The vertical head is driven from the same gearing and the application is very simple. This tool is designated by the manufacturers as their No. 6 milling machine.

Mr. Hiram S. Maxim has consented to write a series of important illustrated articles on the evolution and manufacture of automatic firing guns, the first of which appears in the current issue of *Industries and Iron.*

The Hunt Coupling for Transmission Rope.

The rapid increase in the transmission of power by rope has made prominent one of the minor difficulties attending its use. This is the gradual lengthening of the rope which increases the sag until it become necessary either to resplice the rope or to use a take-up sheave with a very long range of motion. Rapid wear of the rope from slipping on the pulleys is frequently caused by lack of sufficient tension.

The Hunt rope coupling, which we illustrate, is designed to do away with all necessity for resplicing, etc., as it will keep a rope at exactly the right tension for the most effective service and long life, and do this with little or no extra time or attention being given the matter and with no expense other than the first cost of the coupling. The device is made wholly of aluminum bronze and has a tensile breaking strength of 60,000 pounds to the square inch, and an elongation of 20 per cent. in eight inches, which is equal to the strength and toughness of mild steel. It is very simple in its construction, there being but two parts, consisting of a screw and socket. These screw together when the rope is first put on the pulleys and lock securely, so that the coupling can be separated only by using a wrench of special design.

A very important and interesting feature of the coupling when screwed together is an internal swivel and ratchet, which we show in Fig. 3. The swivel permits the joint to yield to the curvature of the pulleys while the ratchet holds the parts from revolving on each other and untwisting the rope.

The Hunt coupling is made smaller in diameter than the rope with which it is to be used, in order that it may not touch the grooves of the pulleys, even when the rope is worn.

Fig. 1.

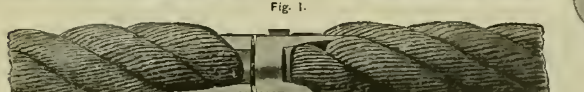


Fig. 2.

Fig. 3

The Hunt Coupling for Transmission Rope.

The rope of the correct length for the drive, when connected up, is spliced into the coupling, and, as it wears longer, more "turns" are put into it by revolving one part of the coupling, the ratchet automatically holding all secure when the rope has the proper length and tension.

Where several independent ropes are run side by side on a pulley, all can be kept at the same tension with the greatest exactness by putting a few more turns in the slack one when such a condition is noticed. By using this coupling, in a multiple rope drive, any single rope can be taken off in a few minutes and the work done by the remaining ones until it is convenient to put on a new rope, which can be done with equal dispatch, and, what is of greater importance, the tension adjusted to correspond exactly with the other ropes. The cost of a rope drive, with this coupling spliced in and installed in position on the pulleys, is usually less than that of ropes spliced on the spot by the purchaser in the ordinary manner, and it is also less than a rope drive with a tension pulley, which, in addition to its cost, frequently requires space that is useful for other purposes. When we consider that a rope requires to be spliced two or three times during its life, while the couplings having no wear are permanent, with no further expense after once installed, it will be seen that this method is much the cheaper as well as the better one.

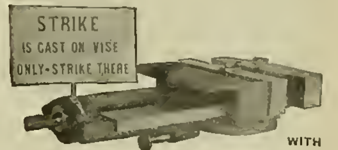
The advantage, both in the convenience of installation, the facility of adjustment of tension, the perfect control of the sag, and the increased life of the rope from a more equal tension, are sufficient to justify an expenditure of many times their cost.

The C. W. Hunt Company, 45 Broadway, New York City, are the exclusive licensees in the United States for the patent on this coupling, and are prepared to furnish transmission rope of the well-known "Stevedore" brand and of the usual sizes with the couplings spliced in position.

An Invitation to Strike.

Some workmen who are careless make a practice of striking the vise of a shaper upon the ends to bring it up square, using a hammer or anything else that happens to be handy, thus bruising the sliding surfaces and in a short time practically ruining the vise for efficient work. The evil effects thus produced are very plainly shown on the engraving of an old vice subjected to just such usage, which can be seen in the vise marked "Without." To prevent this, Gould & Eberhardt, the prominent machine tool builders of Newark, N. J., have been making the new and original style of vise shown above the old vise, which is furnished with all their shapers of latest design, and which does not lessen their usefulness nor reduce their capacity.

In this vise, provision is made whereby it may be tapped on the end for such fine adjustment as may be required



WITH

WITHOUT

without in the least injuring the vise in any way. To keep the matter continually before the workman, the makers have cast the word "Strike" on the vise, also arrow-points showing where to strike. It has often been asked by mechanics why the word "Strike" is cast on this vise. The reason is as explained above.

This is a machine-shop kink of much practical value and is original with Gould & Eberhardt and to be found only on shaper vises of their manufacture.

The Fox Pressed Steel Company.

For several months negotiations have been under way looking to the formation of a large concern to engage in the manufacture of Fox pressed steel trucks, as well as other forms of pressed steel which enter into the construction of railroad equipment These negotiations have been successfully consummated, resulting in the formation of the Fox Pressed Steel Company, composed of New York and Pittsburg capitalists, whose plant will be located in Pittsburg. Ample capital has been provided, and the concern have purchased five acres of ground on the line of the Allegheny Valley Railway, near Fifty-second street, and the work of erecting the plant will be commenced at once. The contract for the erection of the buildings and also for the machinery has been let to Mackintosh, Hemphill & Co., of Pittsburg. This firm will push the work to completion as rapidly as possible, and the new concern expect to be turning out the Fox pressed steel truck about Oct. 1 next.

The plans call for a main building 450 feet long by 112 feet wide. Included in the equipment of this building are 6 power shears, 8 hydraulic presses, 2 bending machines, 11 hydraulic punches, 7 power punches, 24 hydraulic riveting machines, 16 hydraulic cranes, 5 electric cranes, and the necessary straightening tables and other smaller tools. The entire equipment will be of the most modern design. In another building, 350 by 62 feet, will be located the machine shop, blacksmith shop, pump house, boiler house and electric light plant; another and smaller building will contain the gas producers, as it is the intention to use producer gas for fuel.

The location selected for the plant is an admirable one, as the facilities for receiving and shipping material will be all that could be desired. Cars will run right into the building on a private track, and will be loaded and unloaded by overhead electric traveling cranes. The plant will be so constructed that the raw material will be received at one end, put through the various processes of manufacture and loaded on cars at the other end, thus preventing unnecessary and costly rehandling. The entire plant has been carefully designed, and when in full operation is expected to turn out from 300 to 400 finished trucks per day, and to give employment to from 1,000 to 1,200 men.

There are now about 60,000 Fox trucks in use and the demand is constantly increasing. The material for the construction of these trucks will be principally supplied by the Carbon Steel Company of Pittsburgh, and will conform in quality with the specifications of that used by the Fox Solid Pressed Steel Company of Joliet, Ill. It is the opinion of many able and experienced railroad men that the Fox pressed steel truck frame will become the standard truck of this country, and there is no question but that where adopted, it will materially reduce the operating expenses of the road by minimizing the wear and tear of both rails and wheel flanges.

As already stated, the Fox Pressed Steel Company will manufacture all forms of pressed steel that enter into the construction of railroad equipment, in addition to the steel truck.

The American Mannesman Tube Company, of Jersey City, N. J., has been incorporated, with $3,000,000 capital. Buffalo, N. Y., is to be the principal place of business.

The patent litigation between the Consolidated Car Heating Company of Albany, and the Martin Anti-Fire Car Heater Company has been finally adjusted by the purchase of the Martin patents by the Consolidated Company.

Mr. Otto Goetze, who represents in this country the firm of Muller & Mann, manufacturers of rust proof paints and "Mannocitin," a rust preventive for bright parts of machinery, has removed his office to 114 Broad street, New York City.

The Abendroth & Root Manufacturing Company, 28 Cliff street, New York City, have just closed contracts for their Root Improved Water Tube Boiler for the electric light and power plant of the East River Bridge, Musseys new building, and the Electrical Exposition, New York City.

The New York office of the Q & C Company has been removed to Rooms 20, 21 and 22 of the 20th floor of the American Surety Building, 100 Broadway There is nothing like being away up in the world and those who call at these offices on business or pleasure bent, will have an opportunity to see much of the world and of humanity about him.

Mr Alex. Backus, President of the Vulcan Iron Works Company, of Toledo, O., has been made President of the Manufacturers' road, a new belt line just completed in Toledo. The first trip over the line was made March 31 and among the first cars handled was one switched to the Vulcan Iron Works to load a monster Vulcan shovel, which, with three others, is destined for the Mesabi Range.

The Schoen Pressed Steel Company, recently organized in Pittsburg with a capital stock of $1,000,000, have purchased the plant of the Schoen Manufacturing Company, also all of the patents relating to the manufacture of pressed steel specialties owned by the latter concern, including the patents for the manufacture of pressed steel truck frames owned by Charles T Schoen; this truck frame was illustrated by us last month. The Schoen Pressed Steel Company have bought 5½ acres of land adjoining the present plant of the Schoen Machine Company, in Allegheny. The capacity of the present plant is 125 truck frames per day, but when the additions to equipment and buildings now under way have been completed this will be increased to 300 sets per day. There is also being turned out at present about 75 tons per day of pressed steel car bolsters and other patented specialties. This tonnage will probably be doubled.

The Westinghouse Electric Company has issued a call for a special meeting of its stockholders, to be held on June 4, to vote on a proposition to increase its capital to $15,000,000. The present authorized capital is $10,000,000, of which a little more than $9,000,000 has been issued. The object of the increase is stated to be for the purpose of wiping out existing floating debts and providing additional capital for the increase in business which is expected the coming year, and which will be one of the results of the recent agreement entered into with the General Electric Company. It is said that the increase will be authorized because a number of large stockholders who had been consulted before the call was issued have indorsed the proposition. It is said that $3,000,000 of the proposed increase has already been disposed of, but the stock will not be issued until formal action is taken at the stockholders' meeting.

The Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, have taken the contract for a complete water power plant to be installed at the Lachine Rapids in the St. Lawrence River. This power is said to be second only to Niagara Falls in importance, and is owned by the Lachine Rapids Hydraulic and Land Company, Limited, of Montreal, Canada It is located at the famous Lachine Rapids on the St. Lawrence River, about five miles above Montreal. The initial development will amount to 12,000 horse-power. The work of construction has already begun, and the company expect to be prepared to furnish power before the close of this year. They have contracted with the Stillwell-Bierce & Smith-Vaile Company for 60 largest size Victor turbines of the latest pattern, and all machinery needed for transmitting the power of these turbines to the electric generators. This is probably the largest order for such equipment ever placed at one time.—*Iron Age.*

The firm of Bruner, Sprague & Company, 1005 Chamber of Commerce Building, Chicago, Ill., are the sole selling agents for the Salt Mountain Asbestos Company. This company has an immense mine of pure short fiber asbestos, located at Santee, White County, Ga., and is prepared to furnish it at prices so low that it can be used in direct competition with mineral wool and kindred materials; at the same time it is claimed to be far superior to those materials in quality and durability and goes much farther, pound for pound. It is being used by architects and builders for fireproofing, insulating partitions, and deadening floors; by car builders for insulating refrigerator cars and for deadening material in the floors of coaches and sleeping cars; and by locomotive builders and railroads for lagging locomotives and covering steam pipes and boilers. Among the roads using it for boiler lagging are the Chicago & Northwestern and the Chicago and Eastern Illinois roads.

During the past month we received a copy of a formidable looking injunction, which on closer inspection proved to have come from the American Blower Company, of Detroit, and purported to enjoin competitors from claiming to have the "best blowers," while the American Blower Company's "A B C" hot-blast heater is in the market. Appended is a description of the heater. Ordinarily the steam pipes in the heaters of hot blast apparatus are in the form of an inverted letter U, with the ends connected to a cast-iron base. Each series of pipes is placed within the area enclosed by the next larger one, until all the space is occupied. The outside pipe is thus several times longer than the inner or shortest one, and this difference in length is held to cause marked difference in the circulation of the steam, so that some of the heating surface is inefficient. In the "A B C" heater the inner lines of pipe are given convolutions so as to make all pipes of practically the same length, and thus avoid "short circuiting" of the steam. Furthermore, the base is made in two sections, and so designed as to prevent air pockets. The valves and fittings are all at one side of the base for convenience in connecting to them. The company will be pleased to furnish additional information to those interested

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At Rice's Point, opposite the entrance of the harbor at Duluth, Minn., is a coal dock of great size owned by the Ohio Coal Company, which has recently been newly equipped throughout with the most improved appliances for handling coal. The dock is 1,560 feet long and 300 feet wide, a double railway track extending through its center. It has a shed 950 by 150 feet, with watertight roof, for housing all the anthracite coal received, and the daily unloading capacity is 4,000 tons, the coal being handled by the Newell & Ladd self-filling or clam-shell buckets, made specially heavy for digging soft lump coal, while the carriages by which the loaded buckets are conveyed from the dock front to the pockets in the center—160 feet—or dumped at any intermediate point, were made by W. S Boyle & Company, of Chicago. There are ten 60-horse-power Mundy engines and five 100-horse-power boilers, anthracite dust being used as fuel and steam being furnished to the movable towers along each side of the dock by an 8-inch pipe, 3,500 feet long, provided with 125 openings, permitting the making of connection with the main pipe at almost any point where it is necessary to place the hoisting rig. The whole equipment is deemed especially advantageous for the handling of big lump coal, which has heretofore been done by hand labor only.—*Scientific American.*

At the shops of Beaman & Smith, Providence, R. I., a large horizontal boring mill has just been completed for an electrical concern, and is to be used principally in boring out the fields of dynamos. It has an 8-inch spindle and will bore a hole 6 feet in diameter. The spindle can be adjusted to any required height, up to 6 feet from its center to the plates. The maximum distance between housings is 14 feet, and the platen is 8 feet by 19 feet. The gearing, and for that matter all the other parts, are of the best. The spindle passes through bearings that are lined with a thin conical sleeve or bushing of brass or bronze, which by adjustment longitudinally is compressed in the direction of its diameter, so as to compensate for wear of the spindle. The bushings are solid, not split. Another interesting special tool under construction at these shops is a machine for making plug cocks for a pipe line concern. It operates at one time on four plugs on one side of the machine and four shells on the other, and has a capacity of about 8,000 per month. One notable feature of the method of finishing the shells is the fact that no reamer is used to finish the tape hole for the plug. It has been demonstrated by the superintendent of the pipe line, that the work can be done more cheaply and with equal accuracy by finishing the hole with ordinary boring tools.

On the evening of April 16, a meeting was held at the Manufacturers' Club in Philadelphia, to celebrate an event that was not only a source of pleasure to those present but a genuine gratification to the many friends of Queen & Company of that city. Nearly two years ago that well-known firm assigned to Mr. J. G Gray, with assets valued at $400,000 and liabilities aggregating about $184,000. The confidence of the creditors was such that the business was continued without interruption. Now the creditors have been paid in full, the receivership at an end, and the business placed in the company's hands with no liabilities and assets of more than $200,000. The gathering at the Manufacturers' Club was to celebrate this event. Mr. Gray was presented by the creditors with a magnificent set of the Encyclopedia Brittanica, for his skillful management of the business, the several addresses contained much praise for both Mr Gray and Queen & Company. The house of Queen & Company was established in 1853 by James W. Queen, who had previously been a member of the firm of McAllister & Company. He had made the original firm a scientific center, and on establishing the new house he naturally carried with him the scientific connections which he had formed. He was known to all the scientific men of his day, and they delighted to visit his establishment. Mr. Queen instituted the greatly reduced weight in spectacles, as they are now made. He imported the first forms for grinding spectacle glasses that were used in the United States. He made the first kaleidoscope, the first magic lantern, stereopticon, stereoscope, microscope and platina points for lightning rods. In 1858, failing health lead him to seek a partner in the business and he invited Mr. Samuel L. Fox, who had been a lad under him at the old establishment, and was then 24 years of age, to join him as an equal partner. The firm's name then became James W. Queen & Company. In 1870 Mr. Queen retired from business, selling his interest to Mr. Fox, who continued the firm name of James W. Queen & Company, until the year 1893, when the stock corporation of Queen & Company was formed. The assignment which the company was obliged to make in 1894 was due to the expansions, made in good judgment by it, in the manufacturing and store plants in 1892, to meet the increasing demand for scientific instruments and to the business depression which took place in 1893 over the whole world.

John C. Gray, the assignee of the company, has been connected with James W. Queen & Company and Queen & Company since 1882. In the reorganization of the company Mr. Gray assumes the Presidency. Mr. S. L. Fox is Vice-President, and Mr. J. M. Bazel, Secretary and Treasurer.

Our Directory

OF OFFICIAL CHANGES IN APRIL.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Adirondac & St. Lawrence.—Charles H. Burnett has been appointed Purchasing Agent with office at 51 East 44th Street, New York City.

Altoona & Philipsburgh Connecting.—Mr. Henry Levis has been elected President to succeed S. P. Langdon.

Atlantic and Pacific.—C. W. Smith is Receiver and General Manager, with office at Albuquerque, N. M.

Boston & Albany.—Mr. Thomas B. Purves, Jr., has been appointed Superintendent of Rolling Stock, and will have charge of both the locomotive and car departments, with office at Springfield, Mass.

Mr. William B. Taft, now Acting Superintendent of Motive Power, has been appointed Superintendent of Motive Power, with office in Boston.

Mr. C. H. Barnes has been appointed Division Master Mechanic at West Springfield, Mass.

Central Vermont.—Messrs. Charles M. Hays, General Manager of the Grand Trunk, and Edward C. Smith, President of the Central Vermont, were on March 20 appointed Receivers.

Cleveland, Akron & Columbus.—Mr. B. F. Marshall has been appointed Master Mechanic, with headquarters at Mount Vernon, O., to succeed Mr. W. J. Vance, resigned.

Drummond County.—Mr. C. Church has resigned as president.

Eastern Railway of Minnesota.—Mr. Howard James has been appointed Purchasing Agent, with headquarters at Duluth, Minn.

Grand Trunk.—Mr. Hebert Wallis has resigned the position of Mechanical Superintendent, and Mr. F. W. Morse has been appointed his successor.

Gulf & Interstate.—Mr. W. A. Meagher has been appointed Master Mechanic, with headquarters at Galveston, Tex.

Interoceanic of Mexico.—Mr. G. M. Stewart has been appointed General Manager, with headquarters at the City of Mexico.

Los Angeles Terminal Railway.—Mr. T. E. Gibbon has been appointed Vice-President, and Mr. Wm. Wincup Acting General Manager in charge of traffic and operation, vice T. B. Burnett.

Louisville, Evansville & St. Louis.—Mr. G. F. Jarvis' appointment as the sole receiver of the Louisville, Evansville & St. Louis road, to succeed Receivers Hopkins and Wilson, takes effect May 1.

Macon & Birmingham.—Mr. Julian R. Lane has been appointed General Manager.

Macon & Northern.—Mr. Edgar A. Ross has been appointed Receiver in place of Mr. William H. Ross.

Mexican Railway.—Mr. E. G. Evens has resigned as Locomotive Superintendent and Mr. Alfred Atwood has been appointed to succeed him with headquarters at Apizaco, Mexico.

Michigan Central.—On the decease of Mr. C. E. Smart the office of General Master Mechanic was abolished and the office of Superintendent of Motive Power and Equipment created Mr. Robert Miller is appointed to the position, and Mr. R. H. L'Hommedieu becomes General Superintendent.

Middle & East Tennessee Central.—Mr. W. W. Fidler has been appointed General Manager, with office at Hartsville, Tenn.

Norfolk & Ocean View.—The office of General Manager has been abolished and that of Superintendent created Mr. W. A. Barritt, late General Manager, retires, and Mr. Lee D. Mathes is appointed Superintendent.

Northern Ohio.—Mr. John T. Clark has been appointed Master Mechanic with headquarters at Delphos, Ohio.

Ohio Southern.—N. E. Matthews has been appointed Purchasing Agent, with office at Springfield, O., vice C. H. Roser.

Oregon Central & Eastern.—Offices of Master Mechanic and Master Car Builder have been abolished.

Pittsburgh, Lisbon & Western.—C. B. Smith will be General Manager of this road, which is the reorganized Pittsburgh, Marion & Chicago.

Southern.—Third Vice-President W W. Finley has resigned.

St. Louis, Chicago & St. Paul.—Mr. Henry W. Gays has been made General Manager. General Superintendent I. W Fowler has resigned and the office has been abolished.

Wabash.—Mr. F. W. Morse has resigned the position of Division Master Mechanic at Fort Wayne.

Employment.

WANTED.—A Superintendent for a small car works Active, practical and thoroughly up in car building. Address, with references, THE RATHBURN COMPANY, Deseronto, Ont., Canada.

A GRADUATE ENGINEER, of eight years' experience in a special line of railroad supplies, having a large acquaintance among railroad men, and car builders, desires a position where such knowledge and experience will be of value. Address, W. C. S., Room 36, No. 2 Exchange Court, N Y. City.

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